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ABSTRACT

This curriculum guide, one of a series of five publications, provides an introduction to technology systems, as well as a survey of the tools, materials, and processes used by these technology systems. The materials in the guide give students an opportunity to see the similarities between the various technology systems. Through the instruction and the activities, students can become aware of how the different systems interrelate, how they influence everyday life, and how they combine in a technological society. The 19 units of the guide, arragned in 5 sections, cover the following: (1) introduction (to technology and general and laboratory safety); (2) communication (designing, producing, and evaluating messages); (3) construction (designing, planning, building, and finishing structures); (4) manufacturing (systems, materials and evaluation, processes, and process planning); and (5) energy, power, and transporation (energy/power conversion and measurement, power transmission, power control and storage, and transportation systems). Each instructional unit follows a standard format that includes some or all of these basic components: performance objectives, suggested activities for teachers and students, information sheets, assignment sheets, job sheets, transparency masters, practical tests, written tests, and answers to the assignment sheets and tests. All unit components focus on measurable and observable learning outcomes and are designed for use in more than one lesson or class period. (KC)

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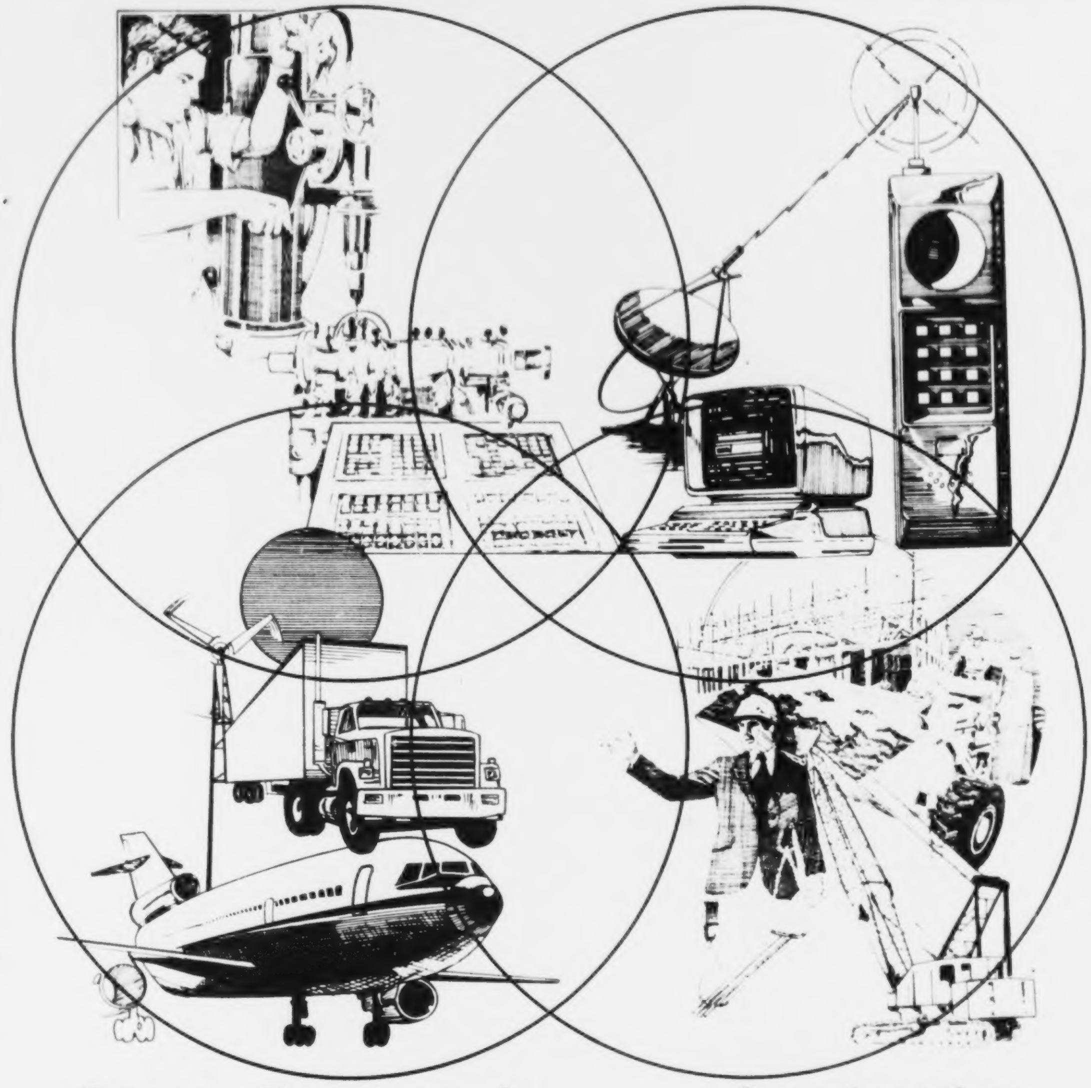
Exploring Technology Education



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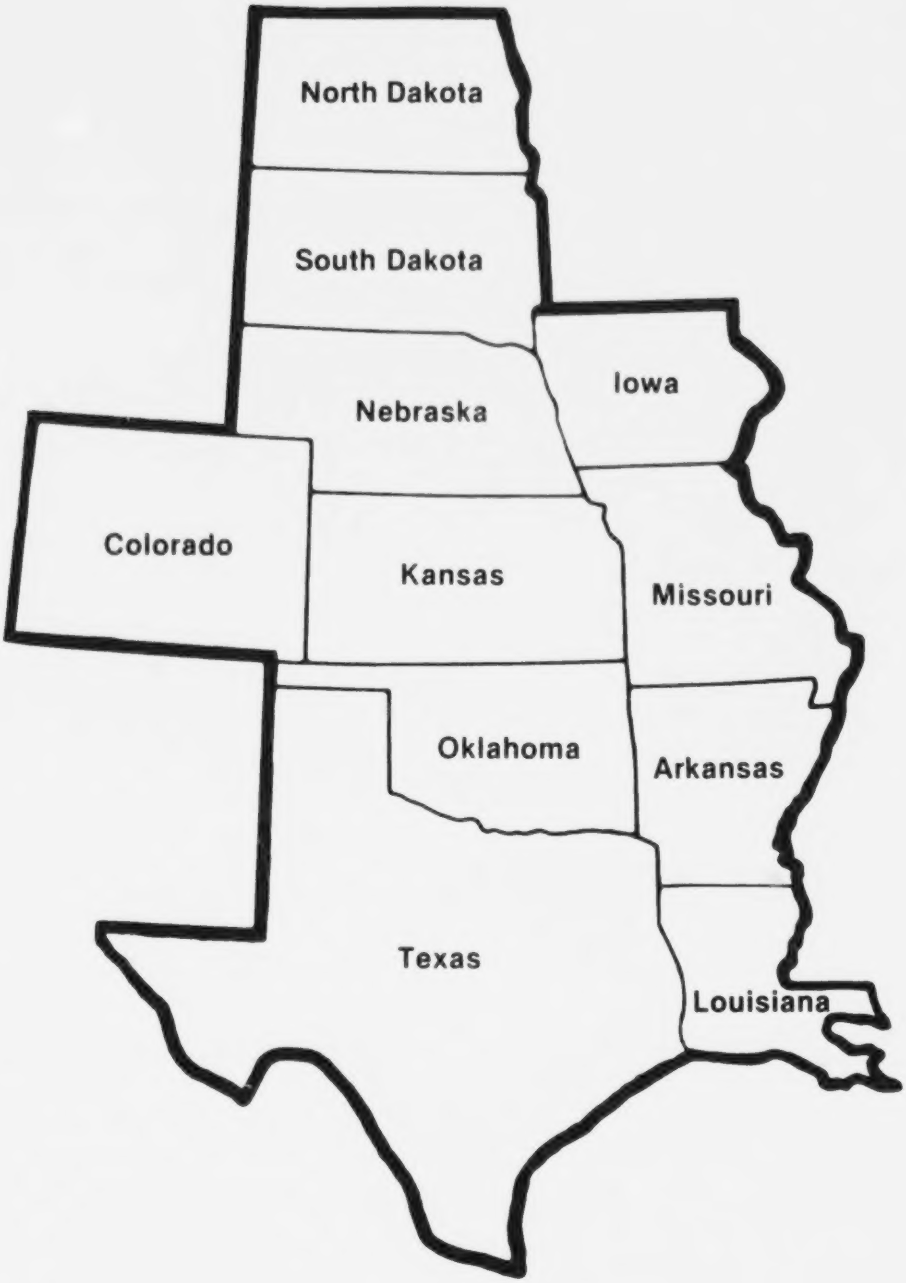
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EXPLORING TECHNOLOGY EDUCATION

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EXPLORING TECHNOLOGY EDUCATION

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FOREWORD

Exploring Technology Education provides an introduction to the technology systems as well as a survey of the tools, materials, and processes used by these technology systems. This publication gives students an opportunity to see the similarities between the various technology systems. Through the instruction and the activities students will become aware of how the different systems interrelate, how they influence our lives every day, and how they combine to make our technological society.

MAVCC's Technology Education Series consists of five publications. The series begins with *Exploring Technology Education,* (Level I), which is followed by four Level II books which individually explore the technology systems. They are entitled *Exploring Construction, Exploring Communication, Exploring Manufacturing,* and *Exploring Energy, Power, and Transportation.* This book, *Exploring Technology Education,* provides the foundation and serves as a building block for progressing into the study of the individual technology systems.

Every effort has been made to make this publication basic, readable, and by all means, usable. Three vital parts of instruction have been intentionally omitted from the publication: motivation, personalization, and localization. These areas are left to the individual instructors and the instructors should capitalize on them. Only then will these publications really become a vital part of the teaching-learning process.

Bob Patton, Chairman
Board of Directors
Mid-America Vocational
Curriculum Consortium

Greg Pierce
Executive Director
Mid-America Vocational
Curriculum Consortium

USE OF THIS PUBLICATION

Instructional Units

Exploring Technology Education contains nineteen units divided into five sections. Each instructional unit includes some or all of the basic components of a unit of instruction; performance objectives, suggested activities for teachers and students, information sheets, transparency masters, assignment sheets, job sheets, practical tests, written tests, and answers to the assignment sheets and tests. Units are planned for more than one lesson or class period of instruction.

Careful study of each instructional unit by the teacher will help to determine:

A. The amount of material that can be covered in each class period
B. The skills which must be demonstrated

   1. Supplies needed
   2. Equipment needed
   3. Amount of practice needed
   4. Amount of class time needed for demonstrations

C. Supplementary materials such as pamphlets or filmstrips that must be ordered
D. Resource people who must be contacted

Objectives

Each unit of instruction is based on performance objectives. These objectives state the goals of the course, thus providing a sense of direction and accomplishment for the student.

Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction; and specific objectives, stating the student performance necessary to reach the unit objective.

Since the objectives of the unit provide direction for the teaching-learning process, it is important for the teacher and students to have a common understanding of the intent of the objectives. A limited number of performance terms have been used in the objectives for this curriculum to assist in promoting the effectiveness of the communication among all individuals using the materials.

Reading of the objectives by the student should be followed by a class discussion to answer any questions concerning performance requirements for each instructional unit.

Teachers should feel free to add objectives which will fit the material to the needs of the students and community. When teachers add objectives, they should remember to supply the needed information, assignment and/or job sheets, and criterion tests.

Suggested Activities for the Instructor

Each unit of instruction has a suggested activities sheet outlining steps to follow in accomplishing specific objectives. Duties of instructors will vary according to the particular unit; however, for best use of the material they should include the following: provide students with objective sheet, information sheet, assignment sheets, and job sheets; preview filmstrips, make transparencies, and arrange for resource materials and people; discuss unit and specific objectives and information sheet; give test. Teachers are encouraged to use any additional instructional activities and teaching methods to aid students in accomplishing the objectives.

Information Sheets

Information sheets provide content essential for meeting the cognitive (knowledge) objectives in the unit. The teacher will find that the information sheets serve as an excellent guide for presenting the background knowledge necessary to develop the skill specified in the unit objective.

Students should read the information sheets before the information is discussed in class. Students may take additional notes on the information sheets.

Transparency Masters

Transparency masters provide information in a special way. The students may see as well as hear the material being presented, thus reinforcing the learning process. Transparencies may present new information or they may reinforce information presented in the information sheets. They are particularly effective when identification is necessary.

Transparencies should be made and placed in the notebook where they will be immediately available for use. Transparencies direct the class's attention to the topic of discussion. They should be left on the screen only when topics shown are under discussion.

Assignment Sheets

Assignment sheets give direction to study and furnish practice for paper and pencil activities to develop the knowledge which is a necessary prerequisite to skill development. These may be given to the student for completion in class or used for homework assignments. Answer sheets are provided which may be used by the student and/or teacher for checking student progress.

Job Sheets

Job sheets are an important segment of each unit. The instructor should be able to demonstrate the skills outlined in the job sheets. Procedures outlined in the job sheets give direction to the skill being taught and allow both student and teacher to check student progress toward the accomplishment of the skill. Job sheets provide a ready outline for students to follow if they have missed a demonstration.

Test and Evaluation

Paper-pencil and performance tests have been constructed to measure student achievement of each objective listed in the unit of instruction. Individual test items may be pulled out and used as a short test to determine student achievement of a particular objective. This kind of testing may be used as a daily quiz and will help the teacher spot difficulties being encountered by students in their efforts to accomplish the unit objective. Test items for objectives added by the teacher should be constructed and added to the test.

Test Answers

Test answers are provided for each unit. These may be used by the teacher and/or student for checking student achievement of the objectives.

ACKNOWLEDGEMENTS

Appreciation is extended to those individuals who contributed their time and talents in the development of *Exploring Technology Education*.

The contents of this publication were planned and reviewed by the following members of the Mid-America Vocational Curriculum Consortium technology education committee:

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Thanks are also extended to **Mary Kellum,** MAVCC Publication Specialist, for her assistance with the editing of this book, as well as the coordination of the entire project.

EXPLORING TECHNOLOGY EDUCATION

INSTRUCTIONAL ANALYSIS

PRACTICAL APPLICATION: What
The Student Should Be Able to Do
(Psychomotor)

RELATED INFORMATION: What
The Student Should Know
(Cognitive)

SECTION A: INTRODUCTION

UNIT I-A: INTRODUCTION TO TECHNOLOGY

1. Terms and definitions
2. Definition of the four systems of technology
3. How the four systems of technology relate
4. Historical changes in technology
5. Types of American industries
6. Essentials of industry
7. Steps in problem-solving
8. Techniques used in problem-solving
9. Identify examples of the four systems of technology in your community
10. Solve a problem as an individual
11. Solve a problem as a group
12. Discuss how the technology systems relate

UNIT II-A: GENERAL AND LABORATORY SAFETY

1. Safety, accident, and first aid
2. Safety color code
3. General laboratory rules

PRACTICAL APPLICATION: What The Student Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What The Student Should Know (Cognitive)
	4. Personal safety rules
	5. Methods used to maintain a clean and orderly laboratory
	6. Classes of fire
	7. Components of the fire triangle
	8. Types of fire extinguishers
9. Complete the safety pledge	
10. Survey the laboratory and identify correct safety practices	
11. Identify safety violations	
12. Identify proper procedures for lifting and using ladders	
13. Properly lift a heavy object	

SECTION B: COMMUNICATION

UNIT I-B: INTRODUCTION TO COMMUNICATION

	1. Terms and definitions
	2. Definition of communication technology
	3. History of communication
	4. Elements of communication
	5. Steps in the communication process
	6. Parts of the communication system
	7. Types of communication

PRACTICAL APPLICATION: What The Student Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What The Student Should Know (Cognitive)
	8. Impact of communication
	9. Careers in visual communication
	10. Careers in audiovisual communication
11. Research a communication device and discuss its possible effect on the future	
12. Send a message in a unique manner	
13. Establish a communication organization to produce a product or service	
14. Research a communication career	

UNIT II-B: DESIGNING MESSAGES

	1. Terms and definitions
	2. Steps in designing a message
	3. Elements of design
	4. Principles of design
	5. Methods of designing preliminary messages
6. Identify elements and principles of design	
7. Improve an advertisement	
8. Design a message	

UNIT III-B: PRODUCING MESSAGES

	1. Terms and definitions
	2. Methods of producing visual messages
	3. Means of transmitting audio-audiovisual messages

PRACTICAL APPLICATION: What The Student Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What The Student Should Know (Cognitive)
	4. Emerging communication transmission technologies
	5. Basic drafting tools and equipment
	6. Units of measure
	7. Alphabet of lines
	8. Orthographic projection views
	9. Steps in developing an orthographic drawing
10. Prepare an oral presentation	
11. Make an oral presentation	
12. Prepare a comprehensive layout	
13. Complete a graphic design	
14. Practice reading units of measure	
15. Complete a three-view orthographic drawing	

UNIT IV-B: EVALUATING MESSAGES

PRACTICAL APPLICATION: What The Student Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What The Student Should Know (Cognitive)
	1. Areas for evaluating a presenter
	2. Points to consider when evaluating an orthographic drawing
	3. Areas for evaluating an organized communication system
	4. Steps used to close an organization
5. Evaluate the communication system	
6. Close the organization	

PRACTICAL APPLICATION: What
The Student Should Be Able to Do
(Psychomotor)

RELATED INFORMATION: What
The Student Should Know
(Cognitive)

SECTION C: CONSTRUCTION

UNIT I-C: INTRODUCTION TO CONSTRUCTION

1. Development of structures
2. Definition of construction technology
3. How construction technology affects society
4. Types of construction
5. Construction technology careers
6. Identify the major types of construction in your community
7. Research a construction technology career
8. Complete a word search of construction careers
9. Sketch a floor plan of a house
10. List construction careers involved in building a house
11. Design a cardboard model house

UNIT II-C: DESIGNING AND PLANNING A STRUCTURE

1. Terms and definitions
2. Components of a construction system model
3. Steps in the construction process
4. Construction materials and their uses
5. Bridge types
6. Units for measuring
7. Graduations on a standard rule

PRACTICAL APPLICATION: What
The Student Should Be Able to Do
(Psychomotor)

RELATED INFORMATION: What
The Student Should Know
(Cognitive)

8. Read a rule
9. Design a truss bridge
10. Utilize the system model to design a construction project
11. Build and stress test a model truss bridge

UNIT III-C: BUILDING THE STRUCTURE

1. Terms and definitions
2. Factors to be considered in clearing a construction site
3. Methods used to clear a site
4. General safety rules for using earthmoving equipment
5. Terms and definitions related to concrete
6. Concrete ingredients and their ratios used in mixing
7. Tools and equipment used in concrete work
8. Types of concrete footings and foundations
9. Tools and equipment used in general construction
10. Precautions to follow in the care of tools
11. Personal safety rules
12. Rules for laboratory safety and maintenance
13. Parts of a floor frame

PRACTICAL APPLICATION: What The Student Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What The Student Should Know (Cognitive)
	14. Parts of a wall frame
	15. Parts of a roof frame
16. Prepare a site	
17. Construct forms for concrete	
18. Perform a slump test	
19. Mix and finish concrete	
20. Build a structure	

UNIT IV-C: FINISHING THE STRUCTURE

	1. Terms and definitions
	2. Types of energy used in construction
	3. Climate control processes
	4. Types of solar systems
	5. Purposes of plumbing systems
	6. Uses of electrical systems
	7. Phases of finishing a project
8. Build and operate a passive solar collector	
9. Finish the structure	

SECTION D: MANUFACTURING

UNIT I-D: INTRODUCTION TO MANUFACTURING

	1. Terms and definitions
	2. Historical perspective of manufacturing
	3. Definitions of production, manufacturing, and construction

PRACTICAL APPLICATION: What The Student Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What The Student Should Know (Cognitive)
	4. Roles of transportation and communication in production
	5. Components of a manufacturing system
	6. Areas of a manufacturing organization
	7. Manufacturing divisions and job titles
	8. Relationship between management and organizational structure
	9. Types of organizational structures
	10. Purposes of general safety rules
11. Participate in a mass production assembly operation	
12. Identify major movements that contributed to the Industrial Revolution	
13. Research and write about an inventor or invention that contributed to the Industrial Revolution	
14. Identify and gather information about two businesses in your community	
15. Describe societal needs that the manufacturing industry has addressed during the last two centuries	
16. Research a manufacturing technology career	
17. Demonstrate group problem solving skills during simulation activities in the laboratory	
18. Identify an organizational structure that is appropriate for use in a classroom manufacturing activity	

UNIT II-D: MANUFACTURING SYSTEMS

PRACTICAL APPLICATION: What The Student Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What The Student Should Know (Cognitive)
	1. Terms and definitions
	2. Types of manufacturing systems
	3. Characteristics of a free enterprise system
	4. Items needed by a manufacturing enterprise
	5. Function of management
	6. Forms of ownership of manufacturing enterprises
	7. Characteristics of individual proprietorships
	8. Characteristics of general partnerships
	9. Characteristics of corporations
	10. Types of corporations
	11. Importance of different forms of ownership in the United States
	12. Legal requirements that affect free enterprise organizations
	13. Characteristics of a license or permit
	14. Methods of obtaining capital resources
15. Complete a blank stock certificate	
16. Sketch three views of a simple object	
17. Identify a product that can be manufactured by your class	

PRACTICAL APPLICATION: What The Student Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What The Student Should Know (Cognitive)

UNIT III-D: MANUFACTURING MATERIALS AND EVALUATION

1. Common manufacturing materials
2. Major types of woods
3. Characteristics of woods
4. Types of metals
5. Characteristics of various types of metals
6. Major types of plastics
7. Properties of plastics
8. Types of earth materials
9. Properties of earth materials
10. Types of composites
11. General properties of materials
12. Considerations when selecting a material
13. Test various properties of two samples of wood and record the results
14. Justify the selection of materials for a simple product

UNIT IV-D: MANUFACTURING PROCESSES

1. Pre-processing, processing, and post-processing operations
2. Primary and secondary manufacturing processes
3. Major types of separating processes
4. Elements of the forming process
5. Steps in the casting process

PRACTICAL APPLICATION: What The Student Should Be Able to Do
(Psychomotor)

RELATED INFORMATION: What The Student Should Know
(Cognitive)

6. Types of conditioning processes

7. Assembly processes

8. Major finishing operations

9. Major types of maintenance

10. General safety rules

11. Tools and machines used for separating

12. Measure distances using both English and metric scales

13. Identify the subassemblies that make up a small hand or power tool

14. Modify a basic design for mass production

15. Operate the scroll saw to make curved cuts

16. Operate the drill press to cut holes in acrylic stock

UNIT V-D: MANUFACTURING PROCESS PLANNING

1. Terms and definitions

2. Major areas within a manufacturing organization

3. Basic functions of the financial affairs and accounting division of a business

4. Purpose of a budget used by management

5. Types of budgets and estimates used within manufacturing organizations

6. Major areas of the industrial relations area of a company

PRACTICAL APPLICATION: What The Student Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What The Student Should Know (Cognitive)
	7. Responsibilities of the research and development area of an organization
	8. Production activities that occur within a company
	9. Major steps that occur during the production phase of a manufacturing operation
	10. Functions of marketing
11. Develop a guide for evaluating production worker performance	
12. Describe worker performance during a mass production activity	

SECTION E: ENERGY, POWER, AND TRANSPORTATION

UNIT I-E: INTRODUCTION TO ENERGY, POWER, AND TRANSPORTATION

	1. Classifications of energy
	2. Forms of energy
	3. Sources of energy
	4. Past, present, and future uses of energy
	5. Environmental and economic impact of various sources of energy
	6. Careers and educational requirements in the energy, power, and transportation fields
7. List personal energy needs and their sources	
8. List personal energy needs and their sources if there were no fossil fuels	
9. Research a career in energy, power, and transportation	

PRACTICAL APPLICATION: What
The Student Should Be Able to Do
(Psychomotor)

RELATED INFORMATION: What
The Student Should Know
(Cognitive)

UNIT II-E: ENERGY/POWER CONVERSION AND MEASUREMENT

1. Terms and definitions
2. Forms of energy
3. Characteristics of energy
4. Types of conversions
5. Types of combustion engines
6. Definitions of energy and power
7. Stages of the basic power theory
8. Measurement of energy and power
9. Identify types of energy used in converting one form of energy into another
10. Solve problems calculating work, horsepower, and torque
11. Build a simple electric motor
12. Build a solar cooker

UNIT III-E: POWER TRANSMISSION, CONTROL, AND STORAGE

1. Terms and definitions
2. Types of power systems
3. Types of fluid power systems
4. Parts of fluid power systems
5. Stages of fluid power systems
6. Stages of electrical power systems and their devices
7. Types of simple machines
8. Functions of machines

PRACTICAL APPLICATION: What The Student Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What The Student Should Know (Cognitive)
	9. Terminology related to machines
	10. Types of motion
	11. Laws of motion
	12. Terminology related to motion
	13. Devices for transmitting and controlling mechanical power
	14. Storing potential and kinetic energy
15. Solve problems calculating velocity and miles per hour	
16. Design a model racer using a system model	
17. Determine the mechanical advantage of a lever	
18. Build a model racer	

UNIT IV-E: TRANSPORTATION SYSTEMS

1. Terms and definitions
2. Parts of a transportation system
3. Purposes of transportation
4. Environmental modes of transportation
5. Transportation "ways"
6. Highway transportation
7. Highway network
8. Railway transportation
9. Air transportation
10. Airways and airports

PRACTICAL APPLICATION: What The Student Should Be Able to Do (Psychomotor)	RELATED INFORMATION: What The Student Should Know (Cognitive)
	11. Water transportation
	12. Types of waterways
	13. Stationary transportation
14. Calculate gas mileage problems	
15. Classify goods, services, and raw materials received and transported from your community	

INTRODUCTION

The world has changed more in the past fifty years than it has throughout all previous history. Technology has contributed more to this change than all other forces. Much of this technology is organized as a productive unit called industry. While science has made enormous contributions by providing us with "truth" or "what is," technology has made its impact by providing us with "know how." Today science and technology are moving ahead in a parallel path. Each assists the other and enables more advances as problems of our era are creatively solved.

The study of technology education should result in your ability to:

A. Adjust to the changing environment.

B. Deal with forces that influence the future.

C. Participate in controlling your own destiny.

Technology education can produce technologically "literate" individuals who are able to participate in and adapt to a dynamic industrial and technical society. Consistent with your ability, interest, and needs as a student of technology education you will:

A. Appreciate the evolution of technology.

B. Establish values on the impact of technology and how it alters our environment.

C. Develop a working knowledge of proper use of tools, techniques, and resources of technological systems.

D. Develop creative solutions to present and future societal problems using technical means.

E. Develop human potentials for responsible work, leisure, and citizenship roles in a technological society.

INTRODUCTION TO TECHNOLOGY
UNIT I-A

UNIT OBJECTIVE

After completion of this unit, the student should be able to distinguish between the systems of technology, discuss how they relate to industry, and utilize problem-solving techniques in relating the systems to society. Competencies will be demonstrated by completing the assignment sheets and the unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to technology with the correct definitions.
2. Match the four systems of technology with the correct definitions.
3. Complete statements concerning how the four systems of technology relate.
4. Select true statements concerning the historical changes in technology.
5. List examples of types of American industries.
6. Select from a list the essentials of industry.
7. Arrange in order the steps in problem-solving.
8. Discuss techniques used in problem-solving.
9. Identify examples of the four systems of technology in your community. (Assignment Sheet #1)
10. Solve a problem as an individual. (Assignment Sheet #2)
11. Solve a problem as a group. (Assignment Sheet #3)
12. Discuss how the technology systems relate. (Assignment Sheet #4)

INTRODUCTION TO TECHNOLOGY
UNIT I-A

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

(NOTE: Transparencies printed on acetate sheets are available as a set for this publication. This set may be purchased from your state curriculum lab or directly from MAVCC by writing to 1500 West Seventh, Stillwater, OK 74074 or by calling toll free 1-800-654-3988.)

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Perhaps the best method for teaching an introduction to technology is by using the systems approach. The systems model will be applied to all four areas covered in this course. This model includes four basic parts: input, process, output, and feedback. Any technological system can be analyzed by using the parts in this model.

2. Technology-based classroom and laboratory activities are a natural base from which to organize and conduct group activities. This can easily be done by initiating and organizing a student organization. A student organization can actually become a part of the course content and become a part of your technology curriculum. A student organization which relates well to technology education is the American Industrial Arts Student Association (AIASA). This organization is the official affiliate of the International Technology Education Association (ITEA).

3. AIASA comprehensive guides and materials for forming a chapter may be obtained from the following:

National AIASA Headquarters
1908 Association Drive
Reston, VA 22091
(703) 860-9000

SUGGESTED ACTIVITIES

4. AIASA conferences are held at regional, state, and national levels. These professional conferences allow the students the opportunity to work and compete with students from other chapters. This atmosphere provides a learning and motivational experience. It is also helpful in developing leadership, problem-solving skills, and good work habits.

5. Alternative activities for Assignment Sheets #2 and #3 include:

   a. Plan a cross-country trip in present or future time.

   b. Plan a trip to the moon.

   c. Plan a trip to a desert island to live for a year.

   d. Plan a city.

   e. Design a subdivision.

   f. Create a communication network for the school.

   (NOTE: Assignment Sheets #2 and #3 are designed to promote creativity and develop problem-solving skills. There are many activities which could be used to promote this.)

6. Show films introducing students to technology and technology education.

7. Discuss how technology has changed your life and the students' lives.

8. Discuss environmental problems caused by technology and present efforts to solve these problems. Also discuss possible future environmental problems and how they may be solved or hopefully prevented.

9. Have students select a local company and discuss how they utilize the four systems of technology. Discuss the interdependence of the four systems.

10. Divide the class into four groups. Have each group select an object which represents one of the systems of technology.

    Examples: Automobile — Energy, power, and transportation
    Computer — Communication
    Office building — Construction
    Any mass-produced item — Manufacturing

    Have each group discuss how the other systems affect the production and use of their object. It is important for the students to appreciate and understand the interdependence of the four systems of technology.

11. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Administer test.

I. Evaluate test.

J. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. *Industrial and Technology Education.* The Technical Foundation of America, Lansing, IL.

B. Williams, Charles F., Kamiran S. Badrkhan, and Willard R. Daggett. *Technology for Tomorrow,* Cincinnati, OH: South-Western Publishing Company, 1985.

C. Groneman, Chris H., John L. Feirer. *General Industrial Education and Technology,* 7th ed, New York: McGraw-Hill Book Company, 1986.

D. Wright, R. Thomas, and Richard M. Henak. *Exploring Production.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1985.

E. *Introduction to Technology, Grade 7.* State of New York Education Department.

F. Heiner, Carl W. and Wayne R. Hendrix. *People Create Technology.* Worcester, MA: Davis Publications, Inc., 1980.

G. Bame, E. Allen and Paul Cummings. *Exploring Technology.* Worcester, MA: Davis Publications, Inc., 1980.

SUGGESTED SUPPLEMENTAL RESOURCES

Visual Aids

A. The following 20-minute tapes may be leased or purchased from:

You, Me, and Technology
Agency of Instructional Technology
Box A
1111 West 17th Street
Bloomington, Indiana 47402
1-800-457-4509

1. *Living with Technology*
2. *Decisions, Decisions, Decisions*
3. *The Technology Spiral*
4. *Energy for Societies*
5. *Health and Technology*

(NOTE: Additional tapes are presently in production.)

B. *Connections,* a PBS Series of videotapes previously broadcasted; available from:

40 West 57th Street
New York, NY 10019

1. *The Trigger Effect*
2. *Death in the Morning*
3. *Wheel of Fortune*

SUGGESTED ACTIVITIES

4. *Long Chain*
5. *Eat, Drink, and Be Merry*
6. *Countdown*
7. *Yesterday, Tomorrow, and You*
8. *Faith in Numbers*
9. *Distant Voices*

Journals and Magazines

(NOTE: The following is a list of publications which are recommended for technology education instructors who wish to stay current with the latest technology developments. Several of these publications are available at no cost to instructors. Those are noted with an asterisk (*).

1. *Popular Science*
2. *Popular Mechanics*
3. *Motor*
4. *School Shop**
5. *Industrial Education**
6. *The Journal (Technology Horizons in Education)**
7. *The Technology Teacher*
8. *Journal of Epsilon Pi Tau*
9. *Modern Photography*
10. *Robotics Age*
11. *Solar Energy*
12. *Home Mechanics*
13. *Manufacturing Forum* (Ball State University, Muncie, Ind.)
14. *Wood and Wood Products*
15. *NASA Technology Briefs**

(NOTE: There are many other periodicals that could be added to this list.)

INTRODUCTION TO TECHNOLOGY
UNIT I-A

INFORMATION SHEET

I. **Terms and definitions**

A. Technology — The systematic application of knowledge and activity to the needs and wants of people

(NOTE: Technology is a way of doing things.)

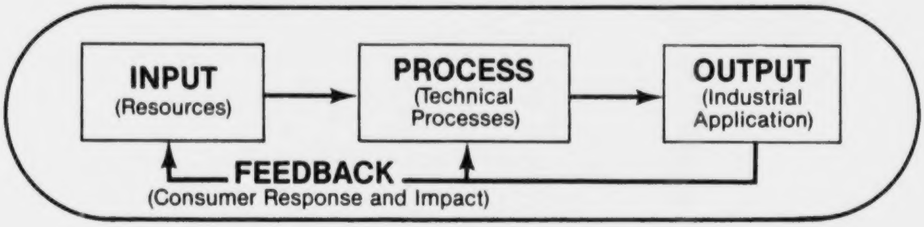
B. Technology education — A program concerned with technical means, their evolution, utilization, and significance with the industrial system, products, and their social/cultural impact

C. System — A group of people, procedures, equipment, and resources that function together to produce desired results

D. Systems of technology — A group of technologies used in combination to deliver products or services that meet demands

E. Systems model — Representation of a systems approach to problem solving which involves the stages of input, process, output, and feedback (Figure 1)

FIGURE 1



F. Industry — An organization that produces goods or services

G. Goods — Material items that are marketable commodities or merchandise

Examples: Clothing, tools, TVs, agricultural products

H. Services — Work that does not produce a tangible commodity or that is for the welfare of others

Examples: Work of doctors, lawyers, teachers, military branches, entertainment industry, banks

INFORMATION SHEET

II. **Four systems of technology**

A. Communication — Changing information into messages that can be transmitted

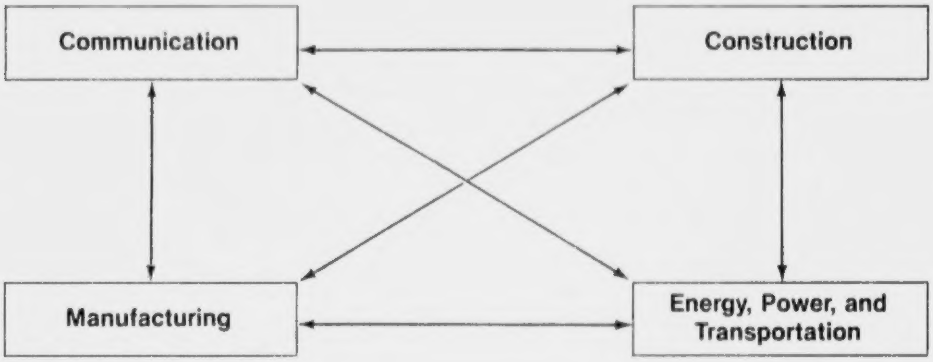
B. Construction — Using manufactured goods and materials to build structures on site

C. Manufacturing — Using materials and processes to produce usable products that are used elsewhere

D. Energy, power, and transportation — Converting energy into mechanical, fluid, and electrical power

III. **How the four systems relate** (Figure 2)

FIGURE 2



A. Communication is the backbone of any organization. Information is exchanged between manufacturing plants, construction sites, and transportation industries.

B. Construction provides highways and railroads for the transportation industry as well as dams to store water for producing electrical power. The construction industry provides structures to house manufacturing and communication enterprises.

C. Manufacturing produces usable products such as construction materials and equipment, computers, machines, automobiles, trucks, and airplanes needed in the other three systems.

INFORMATION SHEET

D. Energy, power, and transportation

1. Energy and power — Produce, store, and transmit power for all other technology systems.

2. Transportation — Moves materials and products for manufacturing, construction, and communication.

IV. Historical changes in technology (Transparency 1)

A. Early civilizations (subsistence living)

1. Food came from hunting animals and wild plants.

2. Shelter was in caves and temporary structures.

3. Most time was used to gather food to stay alive.

4. Travel was limited to areas where hunting was good.

(NOTE: The trigger that allowed society to move out of this age was the discovery and invention of the **plow.** For the first time, people didn't have to use all their time to hunt for food. Now people could produce enough food for larger families and could store it for use in non-growing seasons. People could now store food for travel to more distant areas.)

B. Agrarian Age (Agricultural/handicraft-based economy)

1. Many people worked as farmers growing food.

2. Much of the work was done by hand.

3. People made most of their tools and clothing themselves.

5. Economy was based on bartering.

6. Changes took place very slowly.

7. Education was handled by master/apprentice system.

(NOTE: One trigger that brought change was the **lateen sail.** This sail allowed people to travel further at sea and visit new lands. This permitted trade to begin between distant countries. Another trigger was the steam engine. The development of the **steam engine** by Newcomen and Watt was first used to pump water out of coal mines. Its real effect was the fact that now machines could do some of the work previously done by hand.)

INFORMATION SHEET

C. Industrial (mechanical) age

1. Machines were invented which did work faster and easier.
2. Even fewer people were needed to grow food. People did not have to live close to the food supply. Cities grew.
3. With assembly line production, goods could be made in large quantities in factories.
4. Hand-crafted goods made locally became less important. Many things were sold in stores.
5. Faster transportation by railroads, cars, and airplanes allowed people to travel long distances.
6. Education systems trained for specific job skills.

(NOTE: The trigger that brought change was the **computer.** The development of the computer increased our ability to extend our thinking and decision-making power. This came about because it allowed us to deal more easily with large amounts of **information.** Now an even smaller number of workers is needed to produce goods because a computer can control several machines.)

D. The Information Age (the present and future)

1. We are moving out of the Industrial Age and into the Information Age.
2. Fewer workers are needed to make and grow necessities.
3. More people are needed to process information.
4. Everything around us is changing at a very fast pace.
5. More people work in service jobs.
6. Trade markets are now worldwide rather than local.
7. Communication is now instantaneous.
8. Previously backward countries can modernize faster because of all the information available.
9. Workers can expect to change jobs several times in a lifetime since technology changes their type of work.
10. Education is needed to adapt to rapid change.

INFORMATION SHEET

V. **Types of American industries and examples of each**

A. Mining — Coal, iron, nonferrous metals, petroleum, and nonmetallic ores

B. Construction

1. Residential — Homes

2. Commercial — Office buildings, factories, public buildings, retail business buildings

3. Civil — Railroads, airports, roads, bridges, pipelines, dams, tunnels

C. Manufacturing

1. Durable goods — Lumber and wood products, furniture, glass containers, cement, concrete, gypsum, and plaster, iron and steel, foundries, aluminum, electrical machinery, motor vehicles, aerospace, appliances, instruments, and electronics

2. Nondurable goods — Meat, dairy products, flour and grain, bakery goods, textile products, apparel, pulp, paper, and board, printing and publishing, synthetic materials and plastics, petroleum refining, tires and tubes, footwear, chemicals and drugs, and atomic energy

D. Transportation — Railroads, automobiles, motor freight, water transportation, airlines, and aerospace

E. Power generation — Electrical plants

F. Communication — Telephone and telegraph, electrical power, radio and TV broadcasting, movies, graphic arts, and drafting

G. Services — Hotels, restaurants, insurance, banking, appliance repair, motor-vehicle repair, wholesale trade, retail trade, education, and medical care

H. Agriculture — Dairy, fruit, vegetable, meat, grain, cotton, and tobacco

VI. **Essentials of industry** (Figure 3)

A. Natural resources (materials and energy sources)

Examples: Timber, iron ore, solar energy, water

B. Human resources

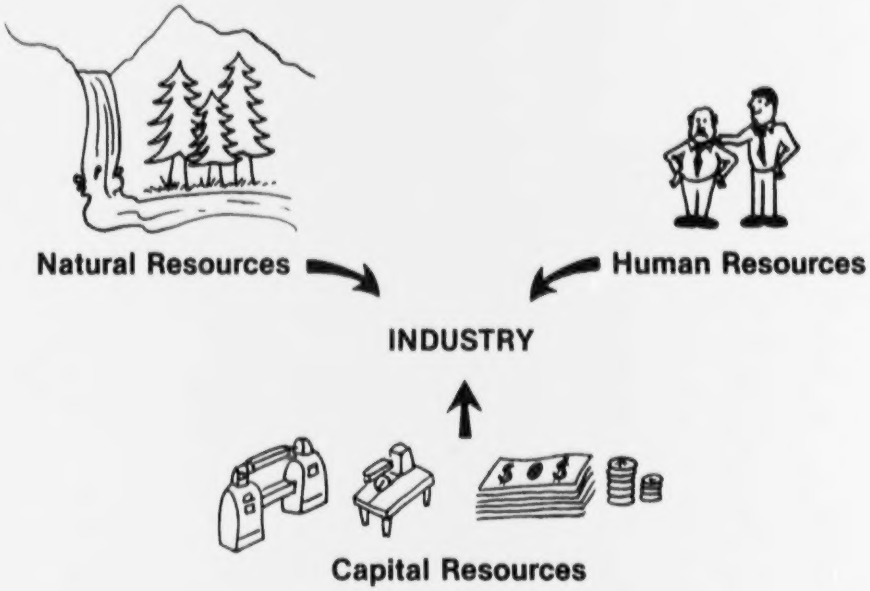
Examples: People involved in production of goods and services, management, office staff, laborers, basic knowledge

INFORMATION SHEET

C. Capital resources

Examples: Factories, equipment, money

FIGURE 3



VII. **Steps in problem-solving** (Transparency 2 and Assignment Sheets #2 and #3)

A. Identify problem.

B. Collect ideas (possbile solutions).

C. Select best solution.

D. Test solution.

E. Evaluate solution. (Collect feedback. Modifications may be needed.)

VIII. **Techniques used in problem solving**

A. Brainstorming — This is usually done in a group. Everyone exchanges ideas, makes suggestions, and the best solution can be chosen.

B. Role playing — A situation or problem is set up and individuals assume the identity of people involved in the situation. A dialogue is carried on to discuss the problem and its solution.

INFORMATION SHEET

C. Trial and error — A solution is chosen that appears to be the "best." That solution is tried. If it does not work, another solution is tried until the problem is solved.

D. Simulations — A scale or sample model of a situation is developed to observe the problem in a setting as near to realistic as possible in order to more clearly see the problem and possible solutions.

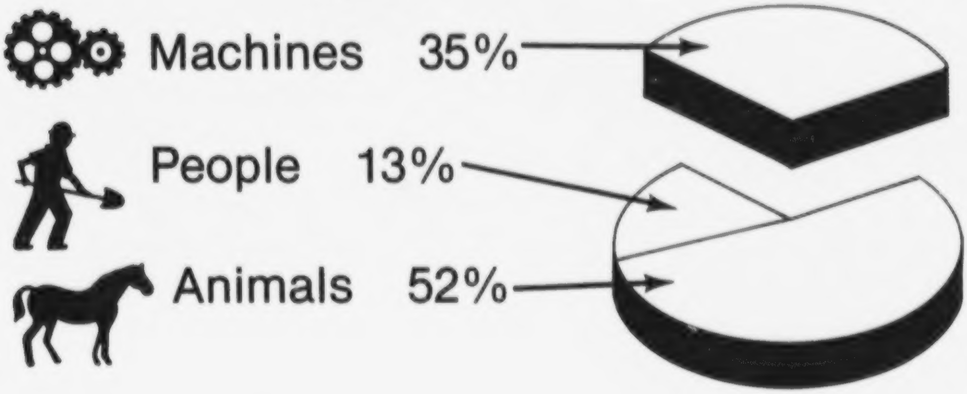
E. Insight — The ability to see into a situation and decide on a possible solution. Insight would be an individual's personal wisdom.

F. Research — This method of problem solving involves making inquiries, searches, or investigations into the problem situation and arriving at the best possible solution.

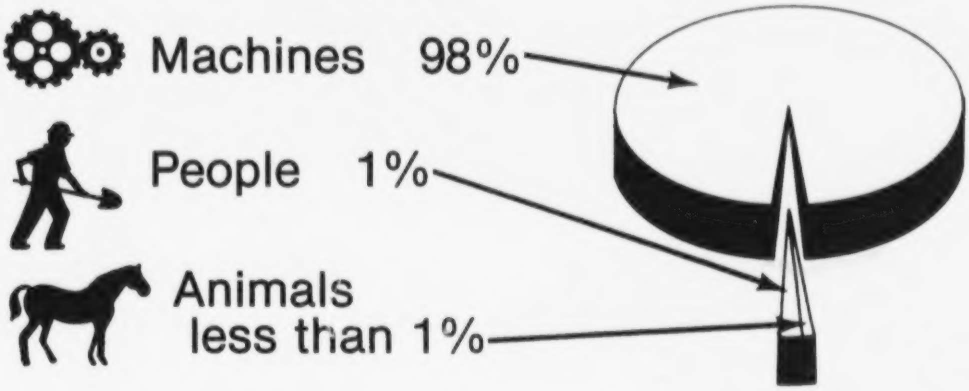
Technology's Changes on Work in the United States

Percentage Done by Machines, People, and Animals

1850

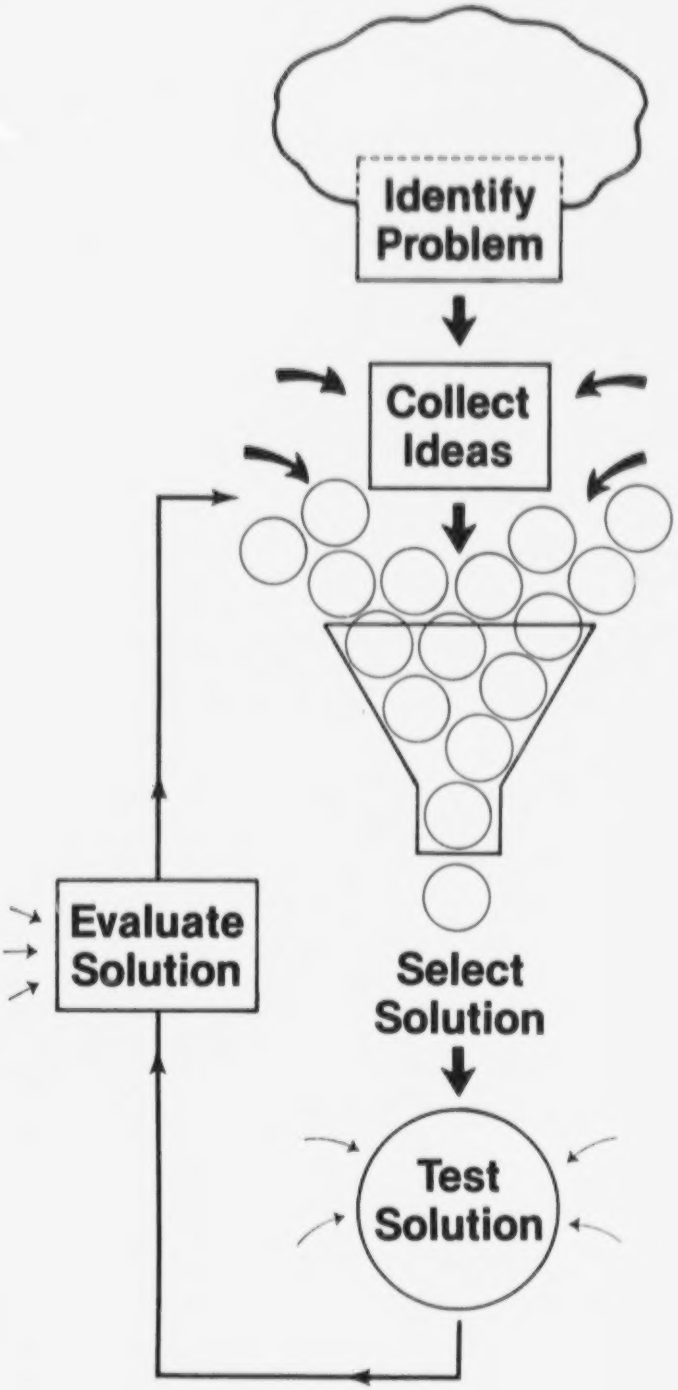


TODAY



Source: U.S. Bureau of Labor Statistics

Steps in Problem-Solving


Identify Problem
Collect Ideas
Select Solution
Test Solution
Evaluate Solution

INTRODUCTION TO TECHNOLOGY
UNIT I-A

ASSIGNMENT SHEET #1 — IDENTIFY EXAMPLES OF THE FOUR SYSTEMS OF TECHNOLOGY IN YOUR COMMUNITY

NAME ______________________________ SCORE __________

Introduction: Every day we come in contact with the systems of technology. In every city, town, or community there are industries (businesses or companies) that are involved in the four systems.

Direction: Listed below are the four systems of technology. Identify industries in your community that are examples of each technology system.

	Technology System	Industry Name
A.	Communication	____________________
		____________________
		____________________
B.	Construction	____________________
		____________________
		____________________
C.	Manufacturing	____________________
		____________________
		____________________
D.	Energy, power, & transportation	____________________
		____________________
		____________________

INTRODUCTION TO TECHNOLOGY
UNIT I-A

ASSIGNMENT SHEET #2 — SOLVE A PROBLEM AS AN INDIVIDUAL

NAME ______________________________ SCORE __________

Directions: Plan a cross-country trip to either Portland, Oregon or Boston, Massachusetts, whichever is farther away from your present location. Pretend that your trip will take place in September, 1885.

(NOTE: Your instructor may wish to change the time or destination.)

Use the five steps of problem solving to arrive at solutions to problems that you might experience on this trip. Answer the following questions:

1. How will you cope with the weather?

2. How do you plan to provide for food for the trip?

3. What clothing will you need?

ASSIGNMENT SHEET #2

4. What other supplies will you need?

5. What mode(s) of transportation will you use?

6. What problems do you think you might have on the trip? How could you handle these problems?

INTRODUCTION TO TECHNOLOGY
UNIT I-A

ASSIGNMENT SHEET #3 — SOLVE A PROBLEM AS A GROUP

NAME ____ SCORE ____________

Directions: Now that you have looked at the problems of a cross-country trip as an individual, there may be advantages in going with an organized group. Form teams or groups as indicated by your instructor. Use one of the following methods to replan the trip:

A. Group brainstorming

B. Role playing

C. Trial and error

D. Simulations

E. Insight

F. Research

What problem-solving technique(s) did your group use?

____

What were the advantages of organizing the trip as a group?

____

____

____

What were the disadvantages of working in a group?

____

____

____

INTRODUCTION TO TECHNOLOGY
UNIT I-A

ASSIGNMENT SHEET #4 — DISCUSS HOW THE TECHNOLOGY SYSTEMS RELATE

NAME ____________________________________ SCORE ____________

Directions: Shown are examples of items we use daily. Notice that they are from each of the technology systems. Discuss how the other systems were used to produce or sell the item.

Example:	Table (Manufacturing)	Used to buy and sell the table (Communication)
		Used to manufacture the product (Energy, power)
		Used to move raw material and finished product (Transportation)
		Built the building where it was made and sold (Construction)
A.	Television program (Communication)	____________________ (Manufacturing)
		____________________ (Construction)
		____________________ (Energy, power)
		____________________ (Transportation)
B.	Residential home (Construction)	____________________ (Energy, power)
		____________________ (Transportation)
		____________________ (Manufacturing)
		____________________ (Communication)

ASSIGNMENT SHEET #4

C. Automobile
(Manufacturing)

____
(Communication)

____
(Construction)

____
(Energy, power)

____
(Transportation)

D. Gasoline
(Energy, power, and transportation)

____
(Construction)

____
(Manufacturing)

____
(Communication)

INTRODUCTION TO TECHNOLOGY
UNIT I-A

NAME ______________________________ SCORE ____________

TEST

1. Match the terms on the right with their correct definitions.

_____a. A group of technologies used in combination to deliver products or services that meet demands

_____b. Representation of a systems approach to problem solving which involves the stages of input, process, output, and feedback

_____c. An organization that produces goods or services

_____d. The systematic application of knowledge and activity to the needs and wants of people

_____e. Work that does not produce a tangible commodity or that is for the welfare of others

_____f. Material items that are marketable commodities or merchandise

1. Goods
2. Industry
3. Services
4. Systems
5. Systems model
6. Systems of technology
7. Technology
8. Technology education
9. Corporation

2. Match the four systems of technology listed on the right with their correct definitions.

_____a. Using materials and processes to produce usable products that are used elsewhere

_____b. Converting energy into mechanical, fluid, and electrical power

_____c. Using manufactured goods and materials to build structures on site

_____d. Changing information into messages that can be transmitted

1. Manufacturing
2. Communication
3. Agriculture
4. Services
5. Construction
6. Energy, power, and transportation

TEST

3. Complete the following statements concerning how the four systems of technology relate by filling in the blanks with the following terms (not all terms must be used): manufacturing, construction, transmit, moves, information, highways and railroads, homes, structures.

   a. Communication is the backbone of any organization. ____________ is exchanged between manufacturing plants and construction sites.

   b. Construction provides ____________ for the transportation industry to travel on as well as dams to store water for producing electrical power. The construction industry provides ____________ to house manufacturing and communication enterprises.

   c. ____________ produces usable products such as construction materials and equipment, computers, machines, automobiles, trucks, and airplanes needed in the other systems.

   d. Energy, power, and transportation

      1) Energy and power — Produce, store, and ____________ power for other systems.

      2) Transportation — ____________ materials and products for other systems.

4. Select true statements concerning the historical changes in technology by placing an "X" next to the true statements.

   _____a. Early civilizations obtained food by going to the market.

   _____b. Agrarian age people made their clothing by hand.

   _____c. Hand-crafted goods were made locally during the mechanical age.

   _____d. It is more difficult for backward countries to modernize during the information age.

   _____e. Today education is needed to adapt to rapid change.

   _____f. Early civilization people had a lot of leisure time.

   _____g. Bartering was used during the agrarian age.

   _____h. Education systems trained for specific skills during the mechanical age.

   _____i. We are presently moving into the mechanical age.

TEST

5. List two examples for each of the following types of American industries.

   a. Mining — ______________________________

   b. Construction — ______________________________

   c. Manufacturing — ______________________________

   d. Transportation — ______________________________

   e. Communication — ______________________________

   f. Services — ______________________________

   g. Agriculture — ______________________________

6. Select from the following list the essentials of industry by placing an "X" in the appropriate blanks.

   _____a. Human resources

   _____b. Training resources

   _____c. Natural resources

   _____d. Synthetic materials

   _____e. Capital resources

   _____f. Monetary resources

7. Arrange in order the steps in problem-solving by placing the correct sequence numbers (1-5) in the appropriate blanks.

   _____a. Collect ideas (possible solutions).

   _____b. Select the best solution.

   _____c. Identify the problem.

   _____d. Test the solution.

   _____e. Evaluate the solution. (Collect feedback.)

TEST

8. Discuss three techniques used in problem-solving.

   a.

   b.

   c.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

9. Identify examples of the four systems of technology in your community. (Assignment Sheet #1)

10. Solve a problem as an individual. (Assignment Sheet #2)

11. Solve a problem as a group. (Assignment Sheet #3)

12. Discuss how the technology systems relate. (Assignment Sheet #4)

INTRODUCTION TO TECHNOLOGY
UNIT I-A

ANSWERS TO TEST

1. a. 6
   b. 5
   c. 2
   d. 7
   e. 3
   f. 1

2. a. 1
   b. 6
   c. 5
   d. 2

3. a. Information
   b. Highways and railroads, structures
   c. Manufacturing
   d. 1) Transmit
      2) Moves

4. b, c, e, g, h

5. Any two from each of the following:
   a. Mining — Coal, iron, nonferrous metals, petroleum, nonmetallic ores
   b. Construction — Homes, railroads, airports, roads, bridges, pipelines, dams, commercial buildings, factories, public buildings
   c. Manufacturing
      1) Durable goods — Lumber and wood products, furniture, glass containers, cement, concrete, gypsum, and plaster, iron and steel, foundries, aluminum, electrical machinery, motor vehicles, aerospace, appliances, instruments, electronics
      2) Nondurable goods — Meat, dairy products, flour and grain, bakery goods, textile products, apparel, pulp, paper, and board, printing and publishing, synthetic materials and plastics, petroleum refining, tires and tubes, footwear, chemicals and drugs, atomic energy
   d. Transportation — Railroads, automobiles, motor freight, water transportation, airlines, aerospace
   e. Communication — Telephone and telegraph, electrical power, radio and TV broadcasting, movies, graphic arts, drafting
   f. Services — Hotels, restaurants, insurance, banking, appliance repair, motor-vehicle repair, wholesale trade, retail trade, education, medical care
   g. Agriculture — Dairy, fruit, vegetable, meat, grain, cotton, tobacco

6. a, c, e

ANSWERS TO TEST

7. a. 2
   b. 3
   c. 1
   d. 4
   e. 5

8. Discussion should include any three of the following:
   a. Brainstorming — This is usually done in a group. Everyone exchanges ideas, makes suggestions, and the best solution can be chosen.
   b. Role playing — A situation or problem is set up and individuals assume the identity of people involved in the situation. A dialogue is carried on to discuss the problem and its solution.
   c. Trial and error — A solution is chosen that appears to be the "best." That solution is tried. If it does not work, another solution is tried until the problem is solved.
   d. Simulations — A scale or sample model of a situation is developed to observe the problem in a setting as near to realistic as possible in order to more clearly see the problem and possible solutions.
   e. Insight — The ability to see into a situation and decide on a possible solution. Insight would be an individual's personal wisdom.
   f. Research — This method of problem solving involves making inquiries, searches, or investigations into the problem situation and arriving at the best possible solution.

9.—12. Evaluated to the satisfaction of the instructor

GENERAL AND LABORATORY SAFETY
UNIT II-A

UNIT OBJECTIVE

After completion of this unit, the student should be able to recognize unsafe situations and state rules for safe laboratory practices. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum score of 100 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Complete statements concerning the terms safety, accident, and first aid.
2. Match the colors of the safety color code with their uses.
3. Select true statements concerning general laboratory rules.
4. Complete statements concerning personal safety rules.
5. Complete statements concerning methods used to maintain a clean and orderly laboratory.
6. Match the classes of fire with their descriptions.
7. Label the components of the fire triangle.
8. Match the types of fire extinguishers with their characteristics.
9. Complete the safety pledge. (Assignment Sheet #1)
10. Survey the laboratory and identify correct safety practices. (Assignment Sheet #2)

OBJECTIVE SHEET

11. Identify safety violations. (Assignment Sheet #3)
12. Identify proper procedures for lifting and using ladders. (Assignment Sheet #4)
13. Demonstrate the ability to properly lift a heavy object. (Job Sheet #1)

GENERAL AND LABORATORY SAFETY
UNIT II-A

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information, assignment, and job sheets.

F. Discuss information, assignment, and job sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Show films which discuss general and laboratory safety. Several films are listed in the "Suggested Supplemental Resources." Others may be available locally.
2. Demonstrate the correct procedure for using fire extinguishers.
3. Review the procedures to follow in case of fires and natural disasters.
4. Order safety posters and display them around the room. Several sources are listed in the "Suggested Supplemental Resources." Others may be available locally.
5. Have a safety poster contest where students design their own posters and a committee of students and/or teachers select the winners.
6. Use Assignment Sheet #2 to familiarize the students with the laboratory and what is expected of them.
7. Plan to teach safety of specific equipment in the area where it will be used.

   (NOTE: Many states have guides for teaching correct use of tools and equipment in industrial arts/technology education laboratories. Check with your state supervisor's office for the availability of such a state guide.)
8. Show safety glasses that are approved for use in your state. Discuss the importance of wearing safety glasses. Discuss personal experiences where safety glasses were not worn and an eye injury resulted.

SUGGESTED ACTIVITIES

9. Show other protective devices and clothing that are required in your laboratory such as ear protection, head gear, aprons, and gloves.

10. Have students participate in an inspection of the classroom and laboratory area for safety compliance or violations. An OSHA or other safety checklist may be used. (See Handout #3)

11. Utilize a laboratory emergency shutdown system if possible. One system is available from:

    Paxton/Patterson
    5719 West 65th Street
    Chicago, IL 60638

12. Maintain a student record file. File safety pledge and all safety tests to document safety teaching.

13. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Administer test.

I. Evaluate test.

J. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. "The ABC's of Fire Protection," Kidde Portable Extinguishers, Walter Kidde and Company, Inc., Belleville, New Jersey 07109.

B. "An Accident Prevention Program for School Shops and Laboratories," U.S. Department of Health, Education, and Welfare, Office of Education.

C. "Safety Practices and Procedures in School Shops," Department of Education, Division of Vocational Education, State of New Jersey.

D. *Accident Prevention for Industrial Arts Vocational and Technical Education Programs.* Oklahoma State Board of Vocational and Technical Education.

SUGGESTED SUPPLEMENTAL RESOURCES

A. Safety films
The following films are available from:
Journal Films, Inc.
930 Pitner Avenue
Evanston, IL 60202

1. *Housekeeping Means Safe Keeping.* Color, 10 minutes.

   (NOTE: This film begins by taking the audience to a typical plant where they are presented with a variety of housekeeping violations. The dangers of these violations are then dramatized in the slow-motion recreation of a painful and realistic accident.)

SUGGESTED SUPPLEMENTAL RESOURCES

2. *Stop a Fire Before It Starts.* Color, 10 minutes.

   (NOTE: In easy-to-understand laboratory demonstrations, this film shows how everyday materials become explosive in the presence of sparks, cigarettes, and so on. From the laboratory, the film moves to typical on-the-job locations where hazardous fire situations are encountered and their blazing conclusions displayed. Most importantly, viewers learn why these situations were hazardous and what could have been done to prevent these fires.)

3. *A New Way to Lift.* Color, 9 minutes.

   (NOTE: This film, produced in conjunction with the National Safety Council, demonstrates body mechanics that apply to all lifting situations. By following these tips, students may avoid serious back injury.)

B. Safety signs, posters, and other films or filmstrips.

1. Underwriters Laboratories, Inc.
   Public Information and Education Services
   207 East Ohio Street
   Chicago, IL 60611

2. National Safety Council
   444 North Michigan Avenue
   Chicago, IL 60611
   1-800-621-7619 (toll-free outside Illinois)

C. *Developing Shop Safety* (film) and *Color Coding* (slides) available from:
AAVIM
120 Driftmier
Athens, GA 30602

GENERAL AND LABORATORY SAFETY
UNIT II-A

INFORMATION SHEET

I. **Terms and definitions**

   A. Safety — State or condition of being safe and free from danger, risk, or injury

   B. Accident — Any sudden, unintentional event which causes personal injury or damage

   C. First aid — Immediate, temporary care given an accident victim until services of a physician can be obtained

II. **Safety color code colors and their uses**

   A. Green

      1. Applied to non-critical parts of equipment and machined surfaces, name plates, and bearing surfaces

      2. Designates the location of safety and first aid equipment

   B. Yellow

      1. Applied to operating levers, wheels, handles, and hazardous areas which may cause stumbling, falling, or tripping

      2. Designates caution

   C. Orange

      1. Applied to electrical switches, interior surfaces of doors, electrical panels, and movable guards

      2. Designates dangerous parts of equipment which may cut, crush, shock, or otherwise injure

   D. Red

      1. Physical color associated with fire

      2. Used to identify the location of fire fighting equipment

      (NOTE: Emergency fire exits shall be designated in red. Buttons or levers for electrical switches used for the stopping of machinery should be designated in red. Gasoline cans should be painted red with additional identification in the form of a yellow band around the can.)

INFORMATION SHEET

E. Blue — Designates caution against starting equipment while it is being worked on, or against the use of defective equipment. (A blue tag should be lettered "Out of Order.")

F. Ivory — Applied to label edges, vise jaws, and edges of tool rests to reflect light and "show the way"

III. General laboratory safety rules

A. Use tools and equipment only for their intended purposes.

B. Return all tools to their proper places after use.

C. Keep all hand tools sharp, clean, and in safe working order.

D. Report any defective tools, machines, or other equipment to the instructor.

E. Retain all guards and safety devices except with the specific authorization of the instructor.

F. Make sure all guards and barriers are in place and adjusted properly before starting a machine tool.

G. Operate machines and tools only after receiving instruction on how to use them safely.

H. Use machinery only under supervision.

I. Follow the specific safety rules for specific machines.

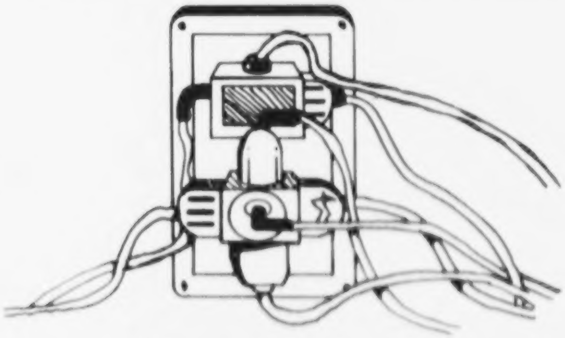
J. Turn off the power and remain at the machine until all moving parts have come to a stop.

K. Disconnect the power from machines before performing the maintenance task of oiling or cleaning.

L. Use correct, properly fitting wrenches for nuts, bolts, and objects to be turned or held.

M. Clean the chips from a machine with a brush — not with a rag or bare hands.

N. Report any unsafe condition or practice in the laboratory immediately.



Overloaded Outlet

INFORMATION SHEET

O. Do not get involved in any horseplay in laboratory or classroom area.

P. Use a solvent only after determining its properties, what it is used for, and how to use it.

(NOTE: *Always* read labels before using a product.)

Q. Report all accidents to the instructor regardless of nature or severity.

IV. Personal safety rules

A. Wear protective equipment as required. (Transparency 1)

1. Approved safety glasses can save your eyesight! There are many hazards that your eyes might come in contact with, so be prepared. (Transparency 2)

2. Ear protection can prevent damage to your hearing.

3. Approved head gear (hard hats) and steel-toed shoes are especially valuable on construction sites.

4. Different kinds of gloves are used to protect your hands from rough surfaces or chemicals.

5. Aprons are required when mixing strong chemicals.

6. Face shields are required when welding.

(NOTE: Contact lens wearers must use extra caution around heat such as welders.)

B. Secure loose clothing and long hair when working around machines or rotating equipment.

Example: Ties, scarves, excessively wide sleeves or pant legs

C. Remove rings and other jewelry when working in the laboratory.

D. Conduct yourself in a manner conducive to safe laboratory practices.

E. Use soap and water frequently as a method of preventing skin diseases and irritations.

F. Work only in well-ventilated areas.

G. Lift heavy objects with your leg muscles, not your back. (Transparency 3)

H. Learn to use a ladder properly. See specific rules on Transparency 4.

INFORMATION SHEET

V. **Methods used to maintain a clean and orderly laboratory** (Transparency 5)

A. Arrange machinery and equipment to permit safe, efficient work practices and ease in cleaning.

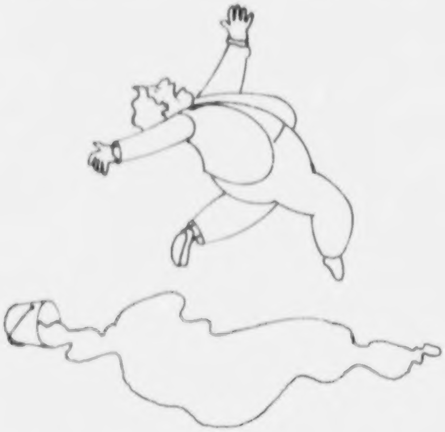
B. Stack materials and supplies safely or store in proper place.

C. Store tools and accessories safely in cabinets, on racks, or in other suitable devices.

D. Clear working areas and work benches of debris and other hazards.

E. Keep aisles, doorways, and areas around machines and equipment clean and clear of debris, paper, and boxes.

F. Keep floors clean and clear of obstructions and slippery substances.



G. Dispose of combustible materials properly or store in approved containers.

H. Store oily rags and other flammable materials such as solvents in self-closing or spring-lid metal containers.

I. Know the proper procedures to follow in keeping the work area clean and orderly.

J. Keep sufficient brooms, brushes, and other housekeeping equipment readily available.

VI. **Classes of fires**

A. Class A — Fires that occur in ordinary combustible materials, such as wood, rags, and rubbish

B. Class B — Fires that occur with flammable liquids, such as gasoline, oil, grease, paints, and thinners

INFORMATION SHEET

C. Class C — Fires that occur in or near electrical equipment such as motors, switchboards, and electrical wiring

D. Class D — Fires that occur with combustible metals such as iron and magnesium

VII. **Three components of the fire triangle** (Transparency 6)

A. Fuel — Any combustible (burnable) material

B. Heat — Enough to raise the fuel to its ignition temperature

C. Oxygen — Necessary to sustain combustion

(NOTE: To produce fire these three elements are necessary and must be present at the same time. If any one of the three is missing, a fire cannot be started or, with the removal of any of them, the fire will be extinguished.)

VIII. **Types of fire extinguishers** (Transparencies 7 and 8)

(NOTE: Other types of fire extinguishers are available for specific applications. The ones listed here are the most common types.)

A. Pressurized water — Used on Class A fires

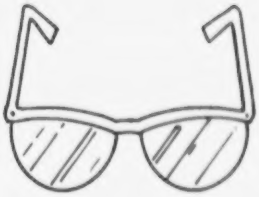
B. Carbon dioxide — Used on Class B and C fires

C. Multi-purpose dry chemical — Used on Class A, B, and C fires

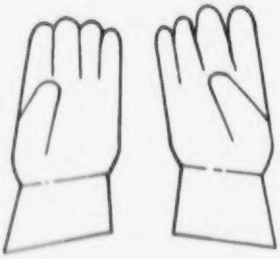
D. Halon gas — Can be used on B and C fires but is primarily used on fires involving computer equipment and circuitry

(NOTE: The ingredients of many fire extinguishers will ruin computer components. Halon gas is the preferred type around this equipment.)

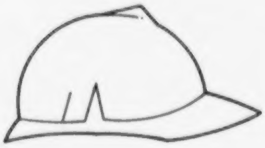
Protective Equipment



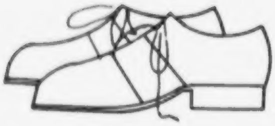
Eye Protection



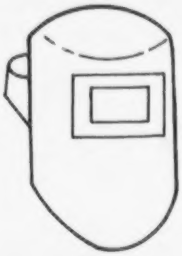
Gloves



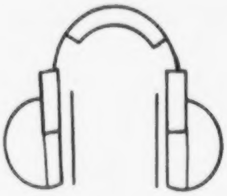
Protective Head Gear



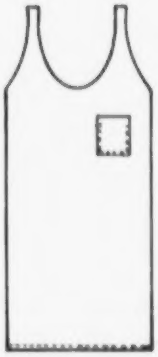
Steel-Toed Shoes



Face Shield

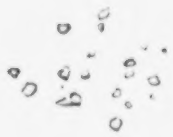


Ear Protection



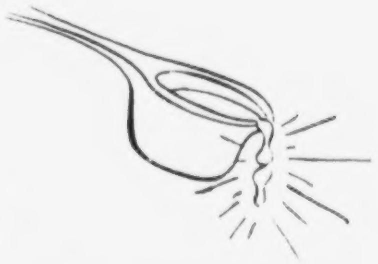
Apron

Principal Eye Hazards

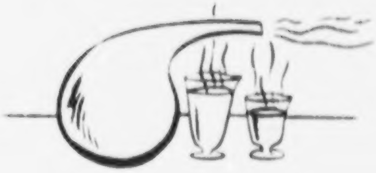


Impact of
Flying Particles

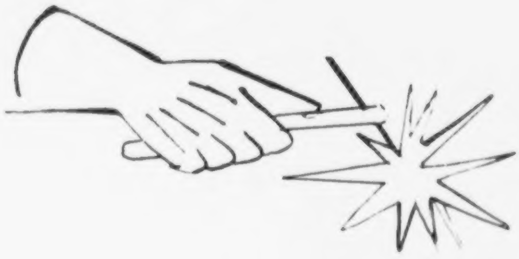
Dusts



Hot Splashing
Metals

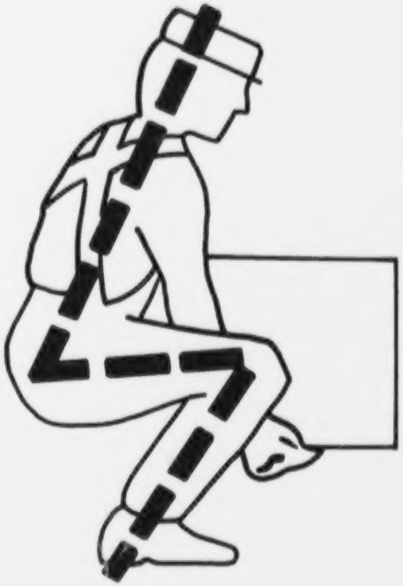


Chemical Fumes
and Liquids

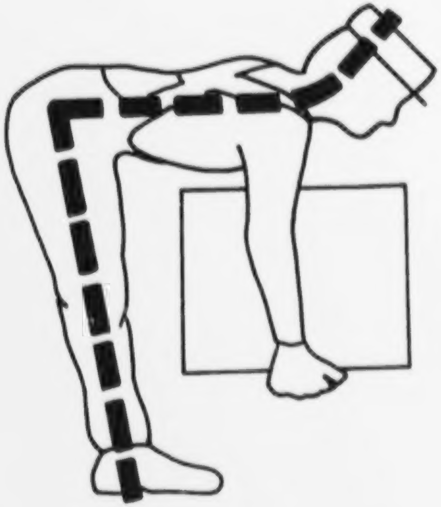


Injurious Light Rays

How to Lift Safely

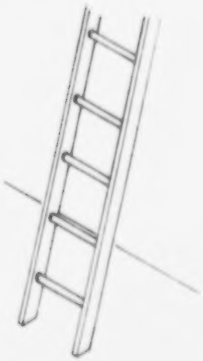


LIFT THIS WAY

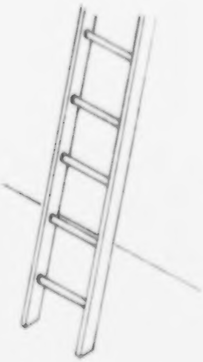


NOT THIS WAY

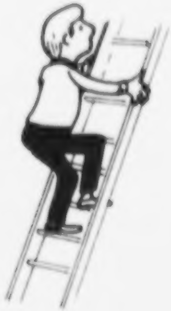
Proper Use of a Ladder



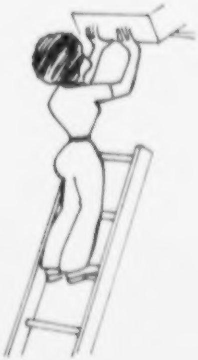
Check for broken or unsafe parts



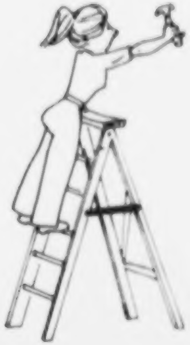
Ladder ¼ length from wall



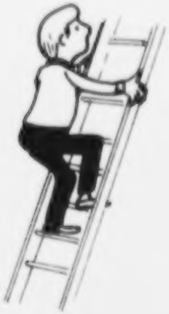
Use both hands



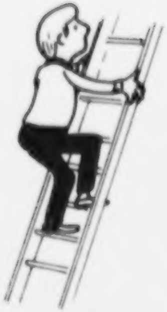
Never stand on top rungs



Open stepladder fully



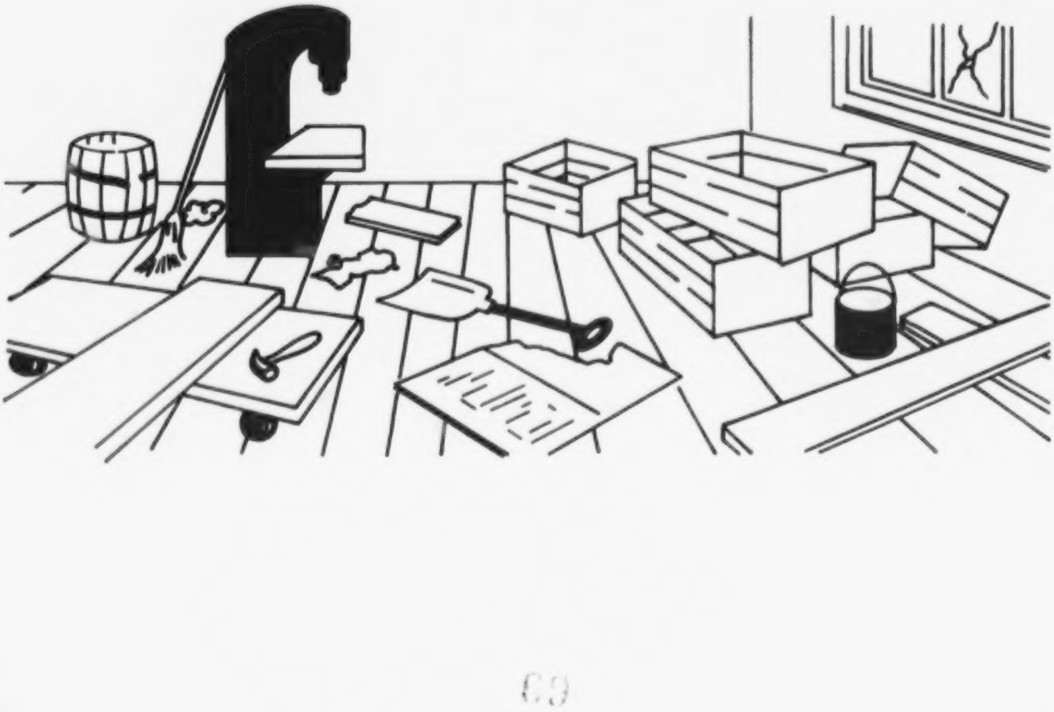
Face ladder when going up or down—never jump off



Only one person on a ladder

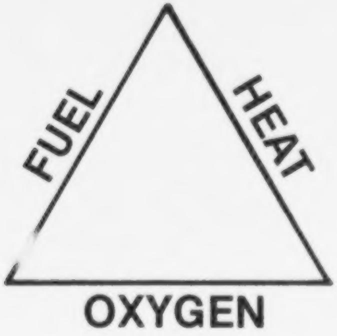
Poor Housekeeping Indicators

1. Objects and Materials on Floors
2. Equipment Out of Place
3. Poor Storage Practice
4. Poor Waste Disposal System
5. Dirty Walls, Windows, and Lights
6. Fire Hazards

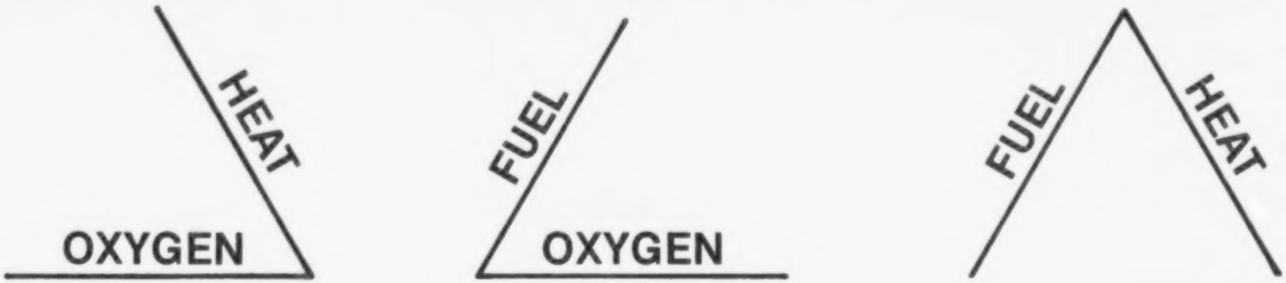


The Fire Triangle

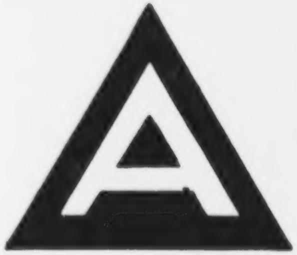
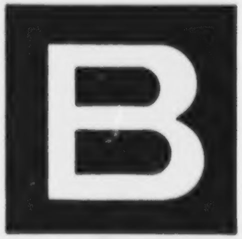
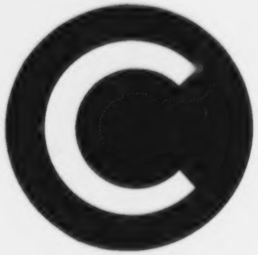
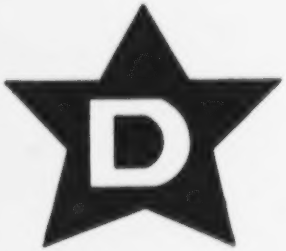
To produce fire, three things must be present at the same time.


FUEL
HEAT
OXYGEN

If any one of the three is missing, a fire cannot be started or, with the removal of any one, the fire will be extinguished.

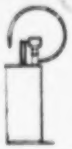
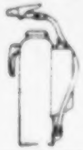
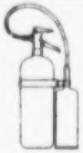
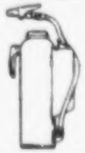
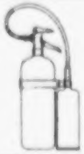
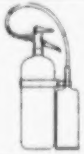
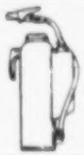
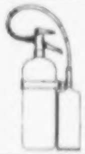
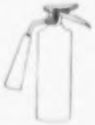

HEAT
OXYGEN
FUEL
OXYGEN
FUEL
HEAT

Standard Letter Symbols for Fire Extinguishers

GREEN	RED	BLUE	YELLOW
			
ORDINARY COMBUSTIBLES	FLAMMABLE LIQUIDS	ELECTRICAL EQUIPMENT	COMBUSTIBLE METALS

Distinctive letters, shapes, and colors mark extinguishers according to the classes of fires on which they should be used.

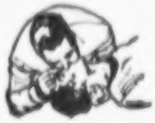
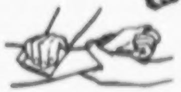
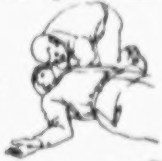
Types of Fire Extinguishers

Type of Fire	Approved Type of Extinguisher				
	Pressurized Water	Carbon Dioxide	Multi-Purpose Dry Chemical	Halon Gas	Dry Powder
Class A Fires ORDINARY COMBUSTIBLES • Wood • Paper • Cloth, etc.					
Class B Fires FLAMMABLE LIQUIDS, GREASE • Gasoline • Paints • Oils, etc.					
Class C Fires ELECTRICAL EQUIPMENT • Motors • Switches, etc.					
Class D Fires COMBUSTIBLE METALS • Iron • Magnesium					

GENERAL AND LABORATORY SAFETY
UNIT II-A

HANDOUT #1 — GENERAL DIRECTIONS FOR GIVING FIRST AID

American
Red Cross

Keep the injured person lying down. **Do not give liquids to an unconscious person.** **Restart breathing with mouth-to-mouth artificial respiration.**  **Control bleeding by pressing on the wound.**  **Dilute swallowed poisons** **and call the Poison Control Center. Keep broken bones from moving.** **Cover burns with thick layers of cloth.** **Keep heart-attack cases quiet and give cardiopulmonary resuscitation (CPR) if it is necessary**  **and if you have been trained. Keep a fainting victim lying flat.** **For eye injuries, pad and bandage both eyes.** **Always call a doctor.**

For more information about these and other lifesaving techniques, contact your Red Cross chapter.

GENERAL AND LABORATORY SAFETY
UNIT II-A

HANDOUT #2 — EMERGENCY NUMBERS

Emergency Telephone Numbers

Rescue Squad ______________________

Fire Department ______________________

Police ______________________

Physician ______________________

Hospital Emergency Room ______________________

Poison Control Center ______________________

Additional Numbers ______________________

When you call for emergency help, tell:

1. WHERE the emergency situation is, with cross streets if possible.
2. TELEPHONE NUMBER you are calling from.
3. WHAT HAPPENED — heart attack, auto accident, fall, etc.
4. HOW MANY persons need help.
5. WHAT is being done for the victims.

NOTE: YOU HANG UP LAST. Let the person you called hang up first.

Record and post emergency telephone numbers in advance so that they will be readily available when you need them.

GENERAL AND LABORATORY SAFETY
UNIT II-A

HANDOUT #3 — OSHA SAFETY CHECKLIST

Hand and Portable Power Tools

1. All hand and portable power tools are in good operating condition: no defects in wiring; equipped with ground wires. Yes No
2. All portable equipment is equipped with necessary guarding devices. Yes No
3. All compressed air equipment used for cleaning operations is regulated at 30 psi or less; chip guarding and personal protective equipment are provided. Yes No

Machine Guarding and Mechanical Safety

1. Every production machine has been inspected as to the following items and found to be in satisfactory operating condition:
    - a) Cleanliness of machine and area Yes No
    - b) Securely attached to floor Yes No
    - c) Operations guarded Yes No
    - d) Illumination Yes No
    - e) Effective cutoff devices Yes No
    - f) Noise level Yes No
    - g) Adjustment Yes No
    - h) Material flow Yes No

Material Hazards

1. All hazardous gases, liquids, and other materials are properly labeled and stored. Yes No
2. Areas where hazardous materials are in use are fire-safe and restricted to authorized employees. Yes No
3. Where X-ray is used, the area is properly shielded and dosimeters are used and processed for all authorized employees. Yes No
4. Protective clothing is worn by employees when oxidizing agents are being used. Yes No
5. All hazard areas are posted with NO SMOKING signs. Yes No
6. All areas where caustics or corrosives are used have been provided adequately with eye fountains and deluge showers. Yes No

GENERAL AND LABORATORY SAFETY
UNIT II-A

ASSIGNMENT SHEET #1 — COMPLETE A SAFETY PLEDGE

NAME ______________________________ SCORE __________

Safety Pledge

It is understood that each student will be given proper instruction in the use of the equipment and in the correct safety procedures concerning the equipment before she or he will be allowed to operate it. The student must assume responsibility for following safe practices. We, therefore, ask that the student subscribe to the following safety pledge.

I will follow all safety rules.

I will never use a machine without first having permission from my instructor or supervisor.

I will not ask permission to use a particular machine unless I have been instructed in its use and have scored 100 percent on the safety test for that machine.

I will report immediately any accident or injury, no matter how minor, to instructor or supervisor.

Student's signature______________________________ **Date**__________

Instructor's signature______________________________ **Date**__________

Parent's or guardian's signature______________________________ **Date**__________

GENERAL AND LABORATORY SAFETY
UNIT II-A

ASSIGNMENT SHEET #2 — SURVEY THE LABORATORY AND IDENTIFY CORRECT SAFETY PRACTICES

NAME ______________________________ SCORE __________

A. What safety practices are being used in your laboratory to promote general safety?

1. ______________________________

2. ______________________________

3. ______________________________

B. What practices are used to maintain an orderly laboratory?

1. ______________________________

2. ______________________________

3. ______________________________

C. Where is your laboratory fire extinguisher located? What type is it, and on what kinds of fires may it be used?

____

____

D. Where is your laboratory first aid kit located? Who is permitted to use it?

____

____

E. What equipment and machines in your lab must you have separate safety tests on before you are allowed to operate them?

____

____

ASSIGNMENT SHEET #2

F. What personal safety protection devices or clothing must you wear while working in the laboratory?

G. What procedure should you follow if you see an accident happen?

GENERAL AND LABORATORY SAFETY
UNIT II-A

ASSIGNMENT SHEET #3 — IDENTIFY SAFETY VIOLATIONS

NAME ________________________________ SCORE ____________

Directions: The following paragraphs show unsafe acts performed by a careless student. List the violations below.

While the instructor was out of the laboratory, a student had to makeup work he had missed in school. He has passed all the safety tests on all the machines in the laboratory so there was no reason why he couldn't catch up. The student was wearing a long-sleeve shirt, rolled up his sleeves and put his watch in his pocket.

The only drill that was available had a frayed cord, but was all right to use because there was only a little bare wire exposed. Before plugging it in, he made sure the locking switch was locked on and that the tool was properly grounded. When he started drilling, he made sure that the cord was looped over his wrist to prevent it from getting in the way of the operations. He did notice that there was a puddle under his feet, but he was able to keep the cord from getting wet.

After drilling the first hole, he made sure that the locking switch was off but did not unplug it because he didn't want to further damage the frayed cord. He then changed the drill bit for a larger hole. His safety glasses kept sliding down his nose, so he took them off because there was not real danger when he was just drilling. When he was finished with the drill, he put it on the floor to keep the bench area from getting cluttered.

He then got out the circular saw to make a few crosscuts. Seeing the possible dangers with the saw compared to the drill, he put his safety glasses back on. He made sure the locking switch was off and then plugged it in. He placed the cord over his shoulder to keep it out of the path of the saw and proceeded to make the cut. The board seemed a little difficult to cut, but he was puzzled because the blade was out as far as it could go and he was only cutting one-inch stock. He then started smelling a strange burning odor, so he immediately turned off the machine and jammed the saw into the wood to stop it as quickly as possible.

He put away the bad saw and then got out another saw to finish the cut. After he finished the cut and released the locking switch, he noticed that the guard had retracted properly so there was no need to wait until the blade had stopped rotating. He then put away the tools and cleaned up his mess like a good student should do.

ASSIGNMENT SHEET #3

List all the safety violations.

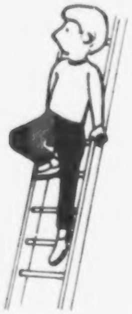
1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________
7. ______________________________
8. ______________________________
9. ______________________________
10. ______________________________
11. ______________________________
12. ______________________________

GENERAL AND LABORATORY SAFETY
UNIT II-A

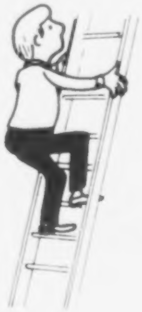
ASSIGNMENT SHEET #4 — IDENTIFY PROPER PROCEDURES FOR LIFTING AND USING LADDERS

Directions: Circle the examples which best represent proper procedures and explain why.

A. 1.



2.

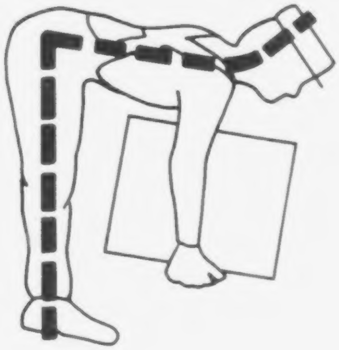


Why?

____

____

B. 1.



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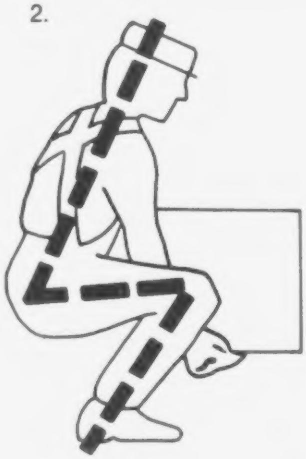


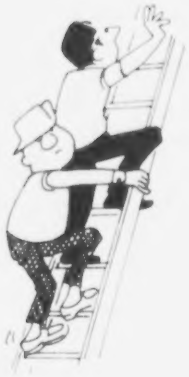
Why?

____

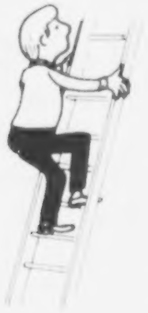
____

ASSIGNMENT SHEET #4

C. 1.



2.

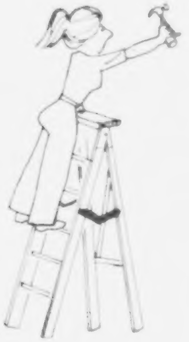


Why?

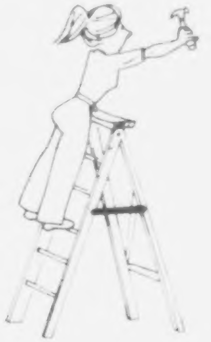
____

____

D. 1.



2.



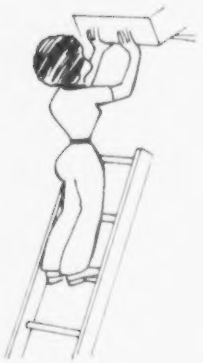
Why?

____

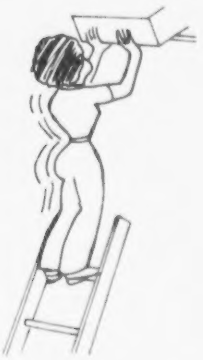
____

ASSIGNMENT SHEET #4

E. 1.



2.

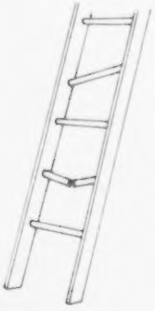


Why?

____

____

F. 1.



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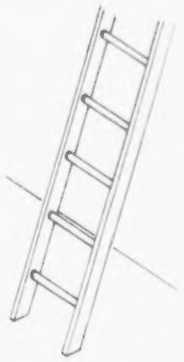


Why?

____

____

GENERAL AND LABORATORY SAFETY
UNIT II-A

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

File completed form in the student's folder.

Assignment Sheet #2

Answers should include answers from Information Sheet Section III and Section V. Use this assignment to stress how each student can assist in maintaining a safe and orderly laboratory

Assignment Sheet #3

1. Do not work in a laboratory without supervision or special permission.
2. Remove or tightly secure loose clothing to the body when working in the laboratory. (Tie)
3. Never use a power tool with a frayed or damaged cord, and report it to the instructor.
4. Before plugging in a power took, make sure the switch is off.
5. Never operate an electrical power tool in or around water.
6. When changing drill bits, always unplug the power tool.
7. Always wear approved eye protection in a laboratory.
8. Put away all tools not being used and keep the floor clear of hazards.
9. Never set the blade to project more than 1/8 inch below the thickness being cut.
10. Never attempt to stop a saw by jamming it into the stock.
11. If anything unusual happens, turn off the power tool and report it to the instructor.
12. Do not lower the saw or set it aside until its blade has stopped rotating.

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #4

A. 2. Face ladder when going up or down.

B. 2. Bend knees to a position that is comfortable, keeping back straight.

C. 2. Allow only one person on a ladder at one time.

D. 2. Open stepladder fully before using.

E. 1. Never stand on the top two rungs.

F. 2. Check for broken or unsafe parts.

GENERAL AND LABORATORY SAFETY
UNIT II-A

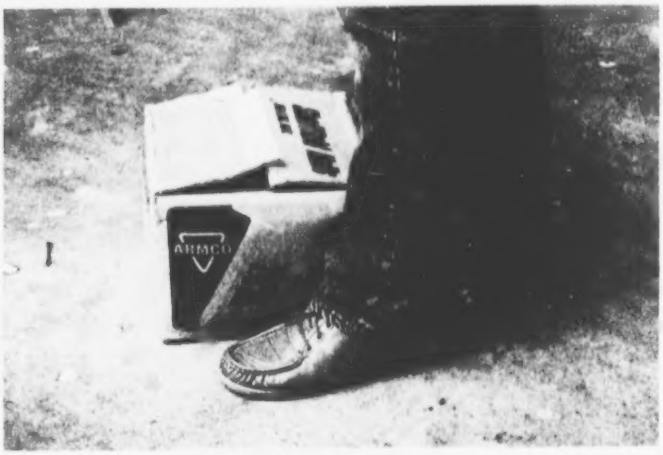
JOB SHEET #1 — PROPERLY LIFT A HEAVY OBJECT

A. Equipment — Heavy object

B. Procedure

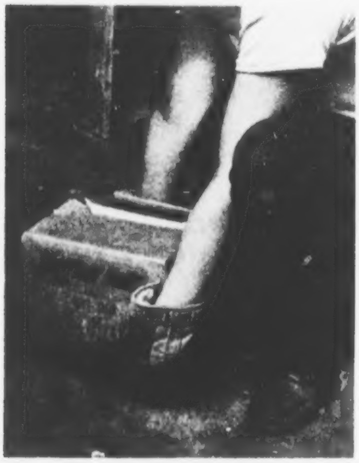
1. Step up to object. Place one foot beside object and one behind. (Figure 1)

FIGURE 1



2. Squat down and grasp object with both hands. (Figure 2)

FIGURE 2



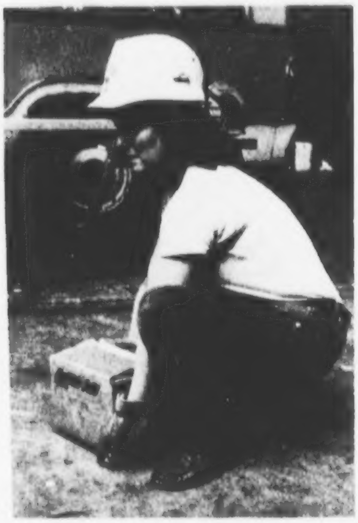
3. Tuck in chin. (Figure 3)

FIGURE 3

JOB SHEET #1

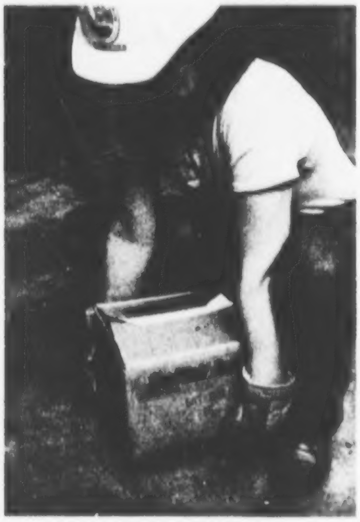
4. Tuck in elbows and arms. (Figure 4)

FIGURE 4



5. Hold load close to body. (Figure 5)

FIGURE 5



6. Keep back straight and body weight directly over feet as you stand up. Use your leg muscles to raise yourself and the object.

FIGURE 6

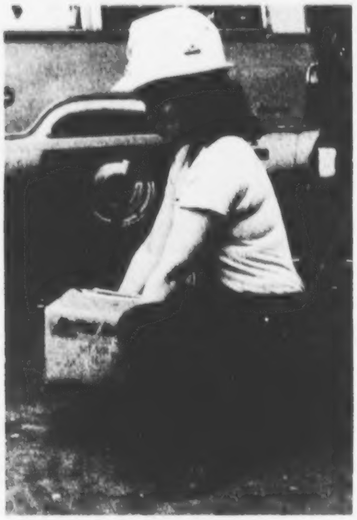
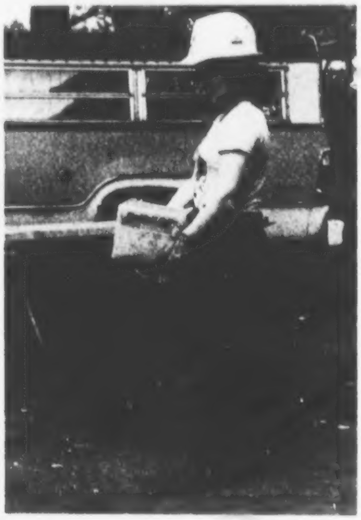


FIGURE 7



GENERAL AND LABORATORY SAFETY
UNIT II-A

NAME ______________________ SCORE ___________________

TEST

1. Complete the following statements.

   a. ____________ is the state or condition of being safe and free from danger, risk, or injury.

   b. Accident is any sudden, unintentional event which causes personal ____________ or damage.

   c. ____________ is the immediate, temporary care given an accident victim until services of a physician can be obtained.

2. Match the following colors of the safety color code with the correct statements of their uses.

   _____a. Designates caution

   _____b. Used to identify the location of fire fighting equipment

   _____c. Designates the location of safety and first aid equipment

   _____d. Designates dangerous parts of equipment which may cut, crush, shock, or otherwise injure

   _____e. Designates caution against starting equipment while it is being worked on or against the use of defective equipment

   _____f. Used to reflect light and "show the way"

   1. Green
   2. Ivory
   3. Orange
   4. Purple
   5. Blue
   6. Red
   7. Yellow
   8. Black
   9. Brown

3. Select true statements concerning general laboratory safety rules by placing an "X" in the appropriate blanks.

   _____a. Keep aisles and doorways cluttered.

   _____b. Turn off power before leaving machines and remain at machine until it comes to a stop.

   _____c. Use tools and equipment for any reason.

TEST

_____d. It is not necessary to ask permission to use machines or tools.

_____e. Report any defective tools or equipment to instructor.

_____f. Use your hand to clean chips from a machine.

_____g. Tools may be put anyplace in the laboratory.

_____h. It is not necessary to clean up spilled liquid.

_____i. Do not get involved in any horseplay.

_____j. You may use machines unsupervised if your instructor will only be away from the room about 10 minutes.

4. Complete the following statements concerning personal safety rules by circling the correct words.

   a. Use (**soap and water, lotion**) frequently as a method of preventing skin diseases and infections.

   b. (**Approved safety glasses, Any glasses**) can save your eyesight.

   c. (**Safety glasses, Face shields**) are required when welding.

   d. Remove (**glasses, jewelry**) when working in the laboratory.

   e. Lift heavy objects with your (**leg, back**) muscles.

5. Complete the following statements concerning methods used to maintain a clean and orderly laboratory by filling in the blanks with words from the following list: Debris, slippery substances, plastic trash containers, metal containers, cabinets

   a. Store oily rags and other flammable materials in ______________.

   b. Keep floors clean and clear of obstructions and ______________.

   c. Keep aisles, doorways, and areas around machines and equipment clean and clear of ______________ and boxes.

   d. Store tools and accessories safely in ______________ or racks.

TEST

6. Match the classes of fire with the correct statements defining each class.

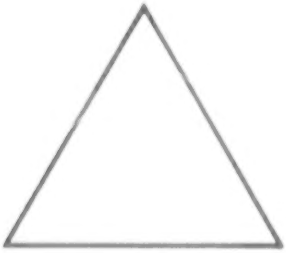
______a. Fires that occur with flammable liquids such as gasoline, oil, or grease

______b. Fires that occur in ordinary combustible materials such as wood, rags, and rubbish

______c. Fires that occur in or near electrical equipment such as motors, switchboards, and electrical wiring

1. Class A
2. Class B
3. Class C
4. Class D

7. Label the three components of the fire triangle.



8. Write the number or numbers of the fire extinguisher best suited to extinguish each class of fire.

______a. Fires that occur near or in computers

______b. Class C fires

______c. Class A fires

______d. Class B fires

1. Pressurized water
2. Carbon dioxide (CO_2)
3. Multi-purpose dry chemical
4. Halon gas

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

9. Complete a safety pledge. (Assignment Sheet #1)

10. Survey the laboratory and identify correct safety practices. (Assignment Sheet #2)

11. Identify safety violations. (Assignment Sheet #3)

12. Identify proper procedures for lifting and using ladders. (Assignment Sheet #4)

13. Demonstrate the ability to properly lift a heavy object. (Job Sheet #1)

GENERAL AND LABORATORY SAFETY
UNIT II-A

ANSWERS TO TEST

1. a. Safety
   b. Injury
   c. First aid

2. a. 7   d. 3
   b. 6   e. 5
   c. 1   f. 2

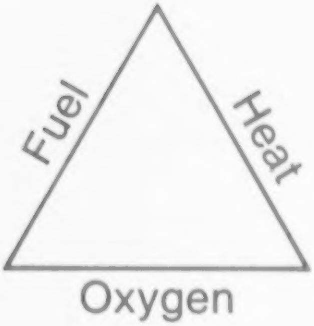
3. b, e, i

4. a. Soap and water
   b. Approved safety glasses
   c. Face shields
   d. Jewelry
   e. Leg

5. a. Metal containers
   b. Slippery substances
   c. Debris
   d. Cabinets

6. a. 2
   b. 1
   c. 3

7.



8. a. 4
   b. 2, 3, 4
   c. 1, 3
   d. 2, 3, 4

9.—13. Evaluated to the satisfaction of the instructor

INTRODUCTION TO COMMUNICATION
UNIT I-B

UNIT OBJECTIVE

After completion of this unit, the student should be able to define communication technology, how it relates to the past, future, and present, and apply the communication system model to establish an organization. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to communication with the correct definitions.
2. Select from a list the definition of communication technology.
3. Complete statements concerning the history of communication.
4. Identify the elements of communication.
5. Identify steps in the communication process.
6. Match parts of the communication system with the correct functions.
7. Distinguish between the types of communication.
8. Discuss the impact of communication.
9. Classify careers in visual communication.
10. Classify careers in audiovisual communication.

OBJECTIVE SHEET

11. Research a communication device and discuss its possible effect on the future. (Assignment Sheet #1)
12. Send a message in a unique manner. (Assignment Sheet #2)
13. Establish a communication organization to produce a product or service. (Assignment Sheet #3)
14. Research a communication career. (Assignment Sheet #4)

INTRODUCTION TO COMMUNICATION
UNIT I-B

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Provide students with objective sheet.

C. Discuss unit and specific objectives.

D. Provide students with information and assignment sheets.

E. Discuss information and assignment sheets.

F. Integrate the following activities throughout the teaching of this unit:

1. Invite professionals from all areas of communication to visit with your students.
2. Have students find pictures of different ways people use communication technology in communicating with each other. Make a display.
3. Give students guidance in project selection. Select a project that will give the students a broad range of experience with communication technology and how it will relate to the technical world. If possible, plan to create profit and goodwill for your department with the project.
4. Plan to integrate student organization activities and events into your communication curriculum. The AIASA competitive events guidelines may be followed for a research paper.
5. Use Handout #1 to communicate to the parents what their children will be doing this session.
6. Use package design as a design problem.
   a. Have each student choose a product or assign a product to be packaged.
   b. Analyze existing package designs. Discuss the strengths and weaknesses of the designs. Discuss why some packages appeal to a particular group of consumers.
   c. Ask your students to disassemble existing packages and produce development drawings of them in the following units.
7. Demonstrate classroom equipment that will be used in communication technology.

SUGGESTED ACTIVITIES

8. Give a demonstration of interference by using a laser or radio signal.

9. Plan to have students role play different careers or sending messages through different types of communication.

10. Institute an interdisciplinary activity such as having students create a message in language arts class and send it in the technology education class.

11. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

G. Administer test.

H. Evaluate test.

I. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Jones, Ronald E. and Janet L. Robb. *Discovering Technology Communication.* Dallas, TX: Harcourt Brace Jovanovich Publishers, 1986.

B. Bame, E. Allen and Paul Cumming. *Exploring Technology.* Worcester, MA: Davis Publishing, Inc., 1980.

C. *AIASA Competitive Events Guidelines.* Reston, VA: National AIASA, 1985.

D. Hauenstein, A. Dean and Steven A. Bachmeyer. *The World of Communications, Visual Media.* Bloomington, IL: McKnight Publishing Co., 1974.

INTRODUCTION TO COMMUNICATION
UNIT I-B

INFORMATION SHEET

I. **Terms and definitions**

A. Communication — A process by which information is exchanged between individuals through a common system of words, symbols, signs, or behavior

(NOTE: Communication may be from person to person, person to machine, machine to machine, or machine to person.)

B. Verbal communication — Using words as a means of exchanging information

Examples: Speeches, letters, memos

C. Non-verbal communication — Exchanging information through signs, symbols, or behavior without the use of words

Examples: Gestures, smells, touches, traffic light

D. Telecommunication — Exchanging information over a distance through the use of electronics

Examples: Telegraph, radio, television, computers

E. Interference — Anything that keeps a message from being communicated clearly; noise

II. **Definition of communication technology —** Techniques, devices, and processes that people use to enhance their abilities to communicate

Examples: Graphic communication (drafting, printing, photography), telecommunication

III. **History of communication** (Transparency 1)

A. Early methods of graphic communication

1. Cave pictures (early people, 15,000 B.C.)
2. Hieroglyphics (Egyptians, 3,000 B.C.)
3. Alphabets (Greeks and Romans)

INFORMATION SHEET

B. Mass printing

  1. Wood cuts (Europe 1400's)
  2. Movable metal type (Europe and Asia, 1450)
  3. Letterpress printing (Colonial America, 1639)
  4. Lithographic process (1700)
  5. Offset press (1905)

C. Photography

  1. Light-sensitive metal and glass plates (Civil War, 1850)
  2. Rolled film (marketed by George Eastman, 1888)
  3. Hologram (1960)

D. Electronic messages

  1. Morse Code/telegraph (1844)
  2. Telephone (1876)
  3. Radio (1895)
  4. Television (1895)
  5. Computers (1944)
  6. Transistor (1947)
  7. Integrated circuit (1959)
  8. Microcomputer (1976)
  9. Laser videodisk player (1978)
  10. Desktop/electronic publishing (1980's)

IV. **Elements of communication** (Figure 1)

A. Sender — Any one or thing that sends a message.

B. Message — Any communication between sender and receiver.

C. Channel — The means through which a message is sent.

INFORMATION SHEET

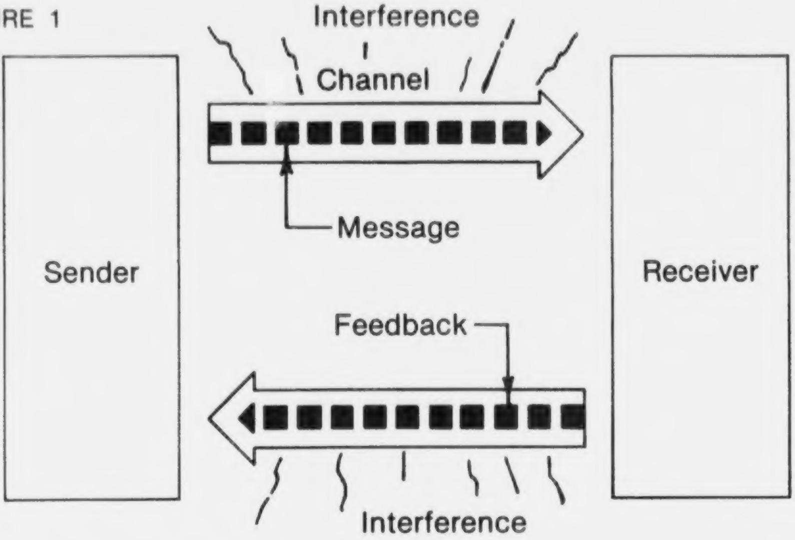
D. Interference — Anything that prevents a message from being communicated clearly; noise.

E. Receiver — One who receives, or gets, a message.

F. Feedback — The reaction or reply one has to a message.

(NOTE: This is necessary to evaluate the effectiveness of the message.)

FIGURE 1



V. **Steps of the communication process** (Transparency 2)

(NOTE: Successful communication depends on both the sender and the receiver understanding the communication process. The four steps listed can be entered at any point, but no steps can be omitted without causing a breakdown in communication.)

A. Encoding — Preparing a message that a person receiving the message will understand

Examples: Perceiving, comprehending, symbolizing, organizing, valuing

B. Transmitting — After the sender encodes the message he or she sends it to the receiver through some means. (Transparency 3)

Examples: Gesturing, touching, speaking, drawing, writing

INFORMATION SHEET

C. Receiving — Takes place when a person accepts a message and is able to recognize its symbols. The five basic senses are used to receive messages. (Transparency 4)

Examples: Seeing, hearing, feeling, smelling, tasting

D. Decoding — To understand and respond to the message

Examples: Perceiving, interpreting, synthesizing, responding

(NOTE: Once a message has gone through the communication process, it can be forgotten or stored in a memory. To recall a message it must be retrieved from your memory bank. Storing and retrieving a message allows it to be repeated.)

VI. **Parts of the communication system** (Figure 2)

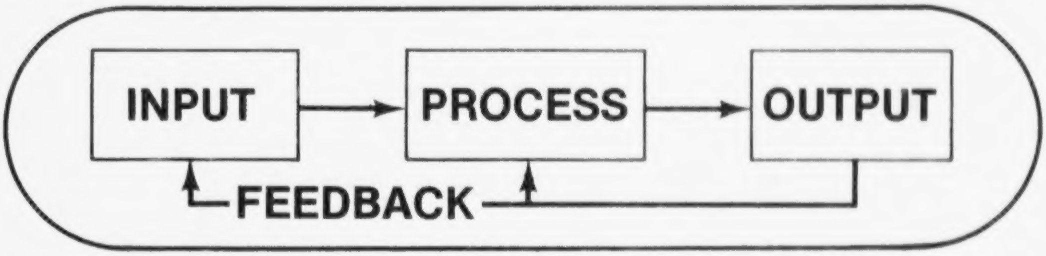
A. Input — The sender gathers necessary resources to develop a message.

B. Process — The sender uses equipment and material to process information.

C. Output — The completed message is sent to receiver.

D. Feedback — The reaction of the receiver. Often the feedback is returned to the sender.

FIGURE 2



VII. **Types of communication** (Transparency 5)

A. Visual communication — Based on our sense of sight.

Examples: Drawings, newspapers, books

B. Audio communication — Based on our sense of hearing.

Examples: Telephones, stereos, tape recorders

INFORMATION SHEET

C. Audiovisual communication — Combines visual and audio messages.

Examples: Movies, television

VIII. Impact of communication technology

A. **Families** experience the impact of communication technology through the stockmarket report in the daily newspaper, listening to the latest recording on the radio, or watching the day's events on a television newscast. Buying an advertised product or receiving a telephone call is also an effect of communication.

B. **Governments** could not operate today without mass media. Communication serves at all levels of government: local, state, and national. Government leaders and journalists keep us informed through the media.

C. **International** events are telecast worldwide almost immediately. Military conflicts, disasters, and political and social events become public information daily. Television and satellite transmission has linked the nations of the world and brought millions entertainment and information.

D. **Industrial/commercial businesses** use communication technology each day to communicate with their employees and to promote their business and products with consumers. The use of computers has increased productivity and in some cases has improved employee safety.

IX. Careers in visual communication

A. Creative careers

1. Designer
2. Photographer
3. Writer
4. Reporter
5. Editor
6. Technical illustrator
7. Drafter
8. Graphic artist

INFORMATION SHEET

B. Trade careers
    1. Press operator
    2. Composer
    3. Camera operator
    4. Image assembly specialist
    5. Platemaker
    6. Bindery worker

C. Management careers
    1. Production manager
    2. Personnel manager

(NOTE: Education and training needed to find employment include high school education, technical school in area of work, community college with a two-year associate degree, or college degree.)

X. Careers in audio-visual communication

A. Creative careers
    1. Radio and television announcer
    2. Actor and actress
    3. Computer programmer
    4. System analyst
    5. Electronic engineer

B. Trade careers
    1. Camera operator
    2. Broadcast technician
    3. Computer operator
    4. Computer service technician
    5. Telephone operator
    6. Telephone service technician

INFORMATION SHEET

C. Management careers

  1. Director

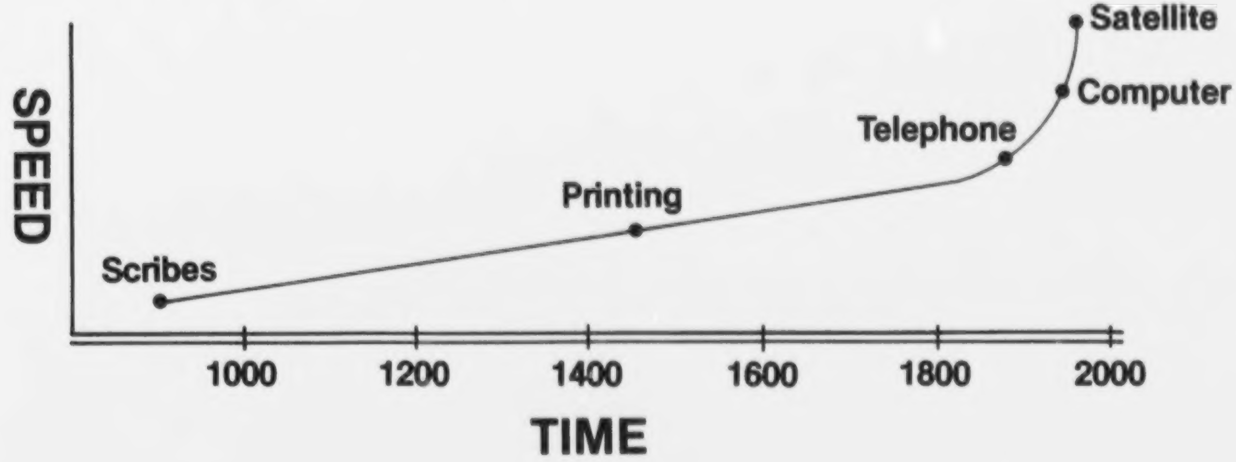
  2. Production manager

  3. Personnel manager

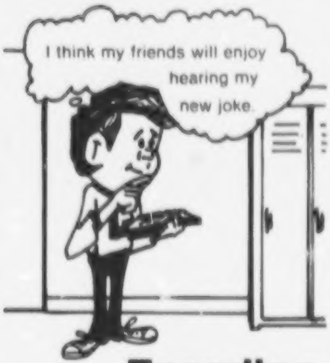
(NOTE: Education and training needed to find employment include high school education, technical school in area of work, community college with a two-year associate degree, or college degree.)

Communication Time Line

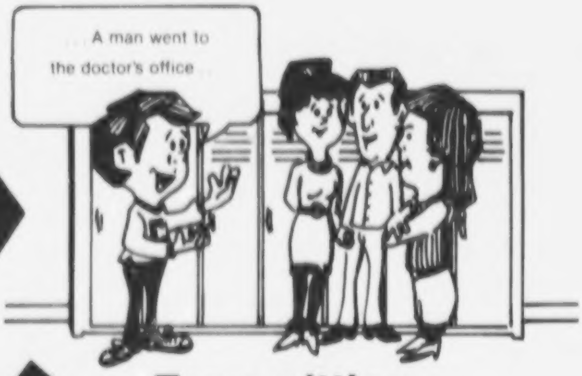
Advances in communication technology create more efficient systems resulting in increased speed of communication.



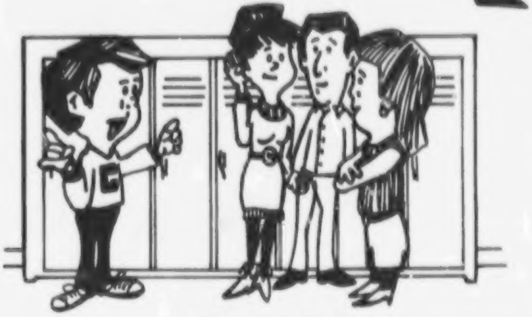
Steps in the Communication Process


I think my friends will enjoy hearing my new joke.

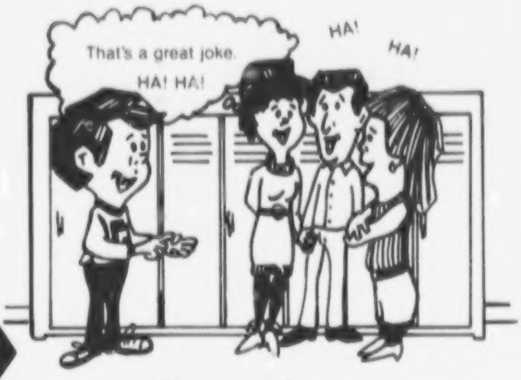
Encoding


. . . A man went to the doctor's office . . .

Transmitting

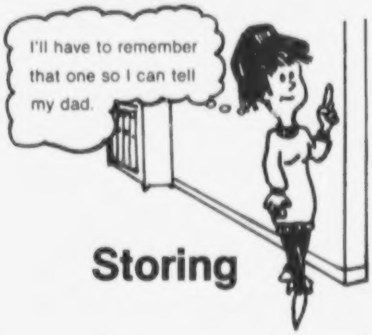


Receiving

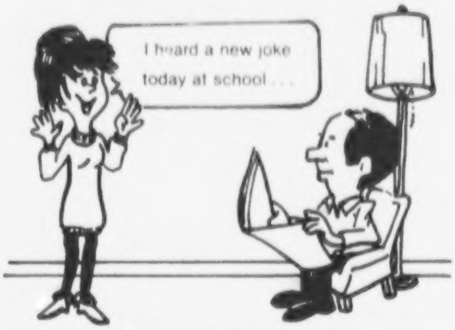

That's a great joke. HA! HA!
HA!
HA!

Decoding

Storing and Retrieving allow the same message to be repeated.


I'll have to remember that one so I can tell my dad.

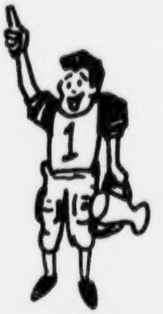
Storing


I heard a new joke today at school . . .

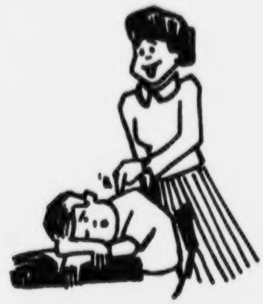
Retrieving

Transmitting Messages

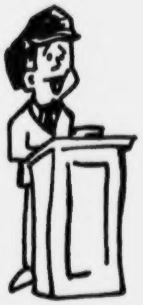
We transmit messages in many ways.



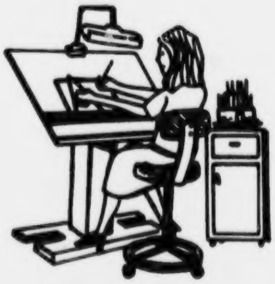
Gesturing



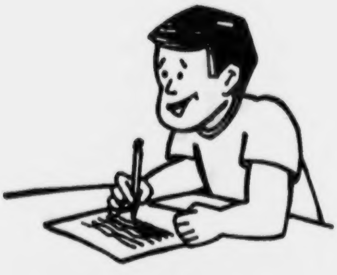
Touching



Speaking



Drawing

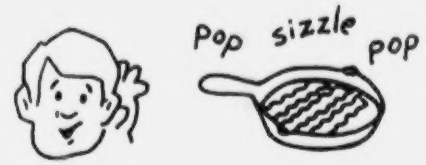


Writing

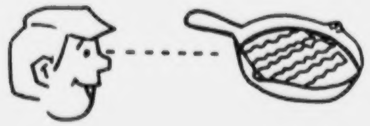
Receiving Messages

We receive messages through our five basic senses.

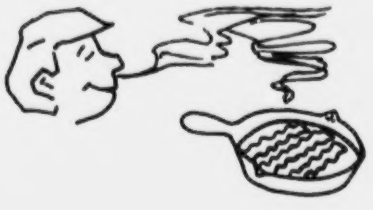
Hearing


pop
sizzle
pop

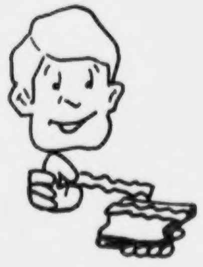
Seeing



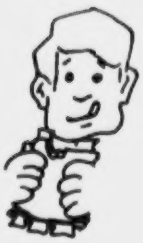
Smelling



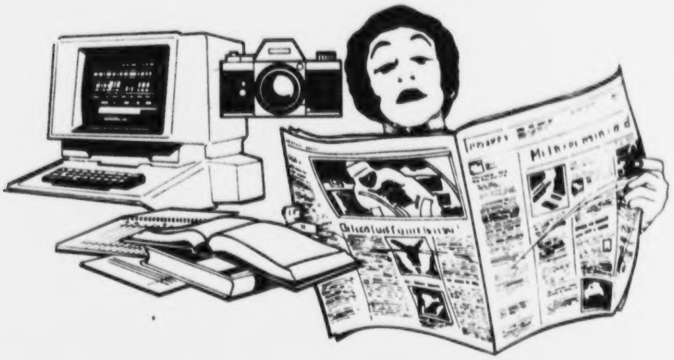
Feeling



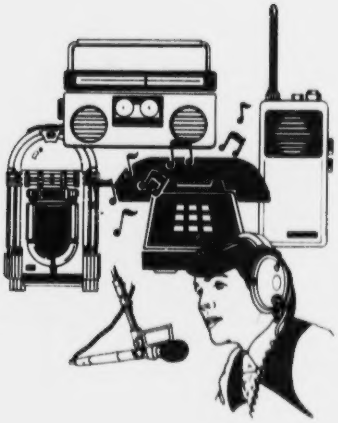
Tasting



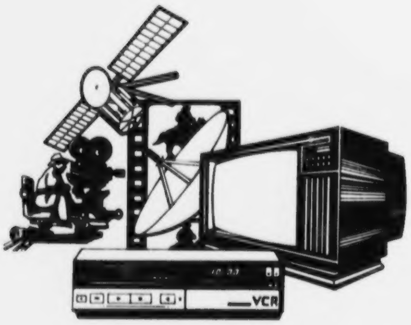
Types of Communication



Visual Communication



Audio Communication



Audiovisual Communication

INTRODUCTION TO COMMUNICATION
UNIT I-B

HANDOUT #1 — PARENT COMMUNIQUE

Dear Parent:

The purpose of this communique is to inform you that ______________________ will be participating in Communication Technology this nine weeks. A number of exciting and challenging activities are planned. A variety of activities are planned including ____.

During this nine weeks of study, technology education students will be using equipment, tools, and chemicals related to this area of study. Safe practices are encouraged in the laboratory and classroom at all times. Please sign and return this letter to me to indicate that you have no objection to your student's participation in these laboratory activities. The student will also sign this letter to indicate a willingness to practice safe work habits.

You are invited to visit our program at any time. Please feel free to call the office to set a time.

Thank you,

____
(Instructor)

I will practice safe work habits in the laboratory at all times.

______________________________ ____________________
(Student's Signature) (Date)

______________________________ ____________________
(Parent or Guardian Signature) (Date)

INTRODUCTION TO COMMUNICATION
UNIT I-B

ASSIGNMENT SHEET #1 — RESEARCH A COMMUNICATION DEVICE AND DISCUSS ITS POSSIBLE EFFECT ON THE FUTURE

NAME ____ SCORE ____________

Directions: Select a communication device.

Examples: Video tape recorder, telephone system, microcomputer, computer-aided design or manufacturing, printing process

Give some information on its effect on society today and discuss how it could affect the future generation. The research information should include history, current status, and effect on the future of the communication device.

INTRODUCTION TO COMMUNICATION
UNIT I-B

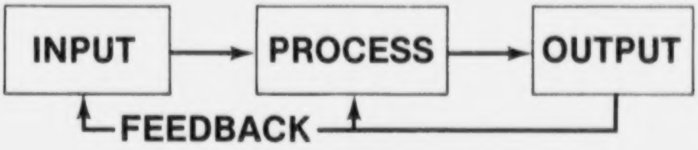
ASSIGNMENT SHEET #2 — SEND A MESSAGE IN A UNIQUE MANNER

NAME ______________________________ SCORE __________

Directions: Select a unique and appropriate way to send a message to some one or thing.

Examples: You want a job.
You must dismiss someone from a job.
You want a date with someone.
You wish to tell a parent something.

Now choose a problem and use the four basic functions of a communications system to solve it.



Your message will be evaluated in the following areas:

- Was the message encoded properly?
- Was the message transmitted well?
- Was the receiver able to understand (decode) the message?
- How did the receiver respond to the message (feedback)?

INTRODUCTION TO COMMUNICATION
UNIT I-B

ASSIGNMENT SHEET #3 — ESTABLISH A COMMUNICATION ORGANIZATION TO PRODUCE A PRODUCT OR SERVICE

NAME ____________________ SCORE __________

Directions: Work as a group or as directed by your instructor and decide the type of organization to be established. Report your decisions to your instructor. Use the following steps.

A. Select a type of communication.

Examples: Printing, photography, drafting, telecommunication (radio, television, telephone), graphic reproduction

(NOTE: Factors to consider in selection are what facilities are available in your laboratory. Follow instructor's directions for selection.)

B. Generate capital.

Examples: Sell product or service in advance, sell stock, use school funds

C. Establish management system and make job assignments.

(NOTE: This involves setting up organizational structure, assigning personnel positions, and acquiring facilities and equipment.)

D. Develop product or service idea.

(NOTE: Use problem-solving techniques to decide what project or product will be used as assignment.)

INTRODUCTION TO COMMUNICATION
UNIT I-B

ASSIGNMENT SHEET #4 — RESEARCH A COMMUNICATION CAREER

NAME ______________________________ SCORE __________

Directions: Examples of careers in the communication field were discussed in the Information Sheet. You may be able to name other careers also. Select a career you think you would be good in. Research for more details.

Examples:
1. What is the exact training needed?
2. Where can you get that training?
3. What are the working conditions for that job?
4. What are the future possibilities of employment?
5. Why would you be good at that job?

Compile the results of your research and present it either in written or oral form as requested by your instructor.

A written research paper should include the following:
- Title page
- Table of contents
- Introduction
- Review of literature (body)
- Conclusion
- Endnotes/footnotes (if applicable)

INTRODUCTION TO COMMUNICATION
UNIT I-B

NAME ______________________ SCORE ____________________

TEST

1. Match the terms on the right with the correct definitions.

   _____a. Using words as a means of exchanging information

   _____b. Exchanging information through signs, symbols, or behavior without the use of words

   _____c. Anything that keeps a message from being communicated clearly; noise

   _____d. Exchanging information over a distance through the use of electronics

   _____e. A process by which information is exchanged between individuals through a common system of words, symbols, signs, or behavior

   1. Verbal communication
   2. Communication
   3. Interference
   4. Visual communication
   5. Telecommunication
   6. Gestures
   7. Non-verbal communication

2. Select the correct definition for communication technology by placing an "X" in the appropriate blank.

   _____a. The use of a thin, flexible strand of pure glass to send a light beam

   _____b. The use of materials, labor, equipment, methods, and management resources efficiently to produce a structure on site

   _____c. The use of techniques, devices, and processes by people to enhance their ability to communicate

3. Complete the following statements concerning the history of communication by circling the correct words.

   a. **(Hieroglyphics, Cave pictures, Greek and Roman alphabets)** were the **earliest** forms of graphic communication.

   b. **(Letterpress, Offset)** printing began to be used in the 1600's.

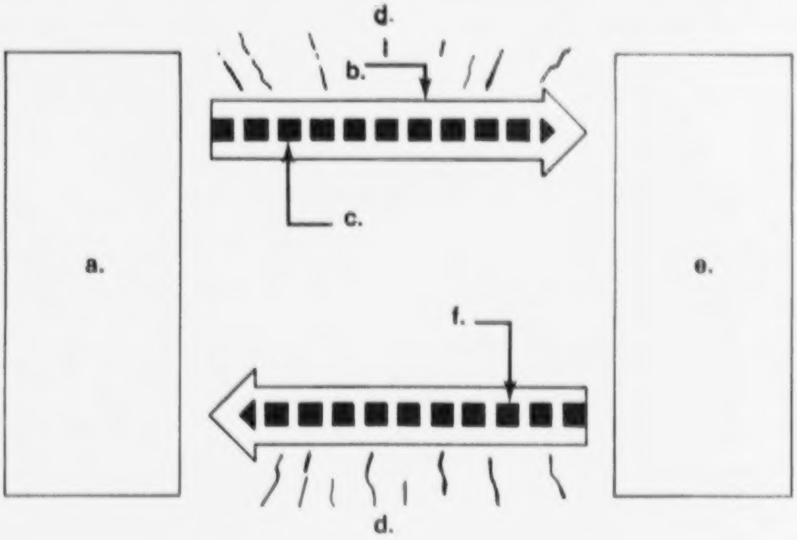
   c. Rolled film for photography was first marketed in 1888 by **(Sam Kodak, George Eastman)**.

TEST

d. The first electronic messages were sent by (**telephone, telegraph**).

e. The computer was invented in (**1944, 1969**).

4. Identify the elements of communication by filling in the blanks below.



a. ______________________________

b. ______________________________

c. ______________________________

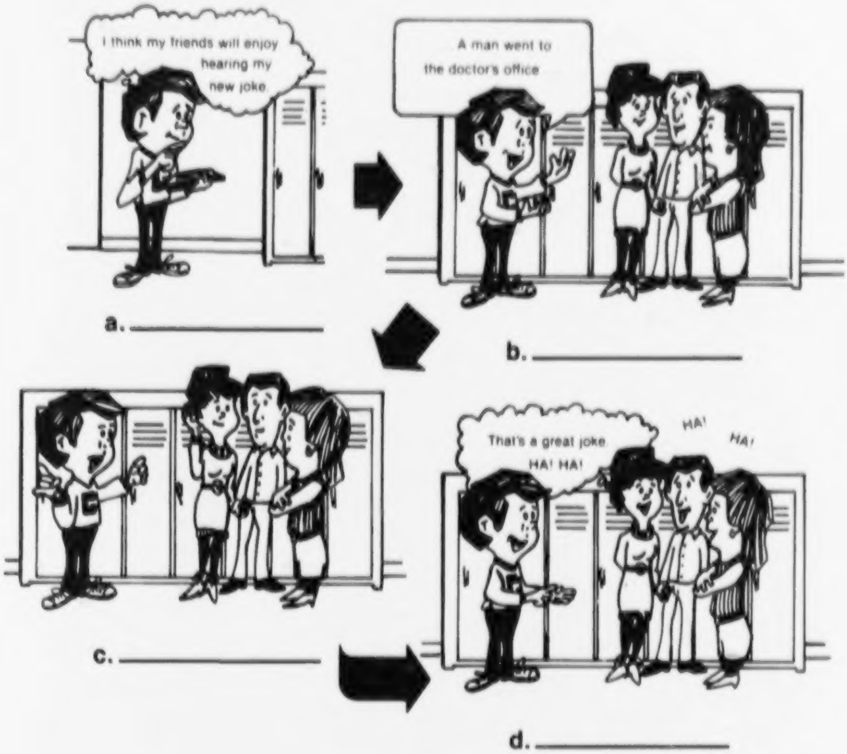
d. ______________________________

e. ______________________________

f. ______________________________

TEST

5. Identify the steps in the communication process by writing the following words in the correct blanks: Receiving, decoding, transmitting, encoding


I think my friends will enjoy hearing my new joke.
a. ______________
A man went to the doctor's office
b. ______________
c. ______________
That's a great joke. HA! HA!
HA!
HA!
d. ______________

6. Match terms on the right with the correct definitions.

_____a. Completed message is sent to receiver

_____b. Reaction of the receiver

_____c. Gathers necessary resources to develop a message

_____d. Uses equipment and material to process information

1. Process
2. Output
3. Feedback
4. Input
5. Development

TEST

7. Categorize the following examples according to the type of communication by placing the following letters next to the appropriate examples:

V — Visual
A — Audio
AV — Audiovisual

_____a. Television

_____b. Stereo record players

_____c. Newspapers

_____d. Drawings

_____e. Tape recorders

_____f. Movies

_____g. Telephones

_____h. Books

8. Discuss the impact of communication technology on the following areas of our society:

a. Families — ____

____

b. Governments — ____

____

9. Classify the following careers in visual communication by placing a "C" next to the creative careers, a "T" next to the trade careers, and an "M" next to the management careers.

_____a. Camera operator

_____b. Writer

_____c. Bindery worker

_____d. Designer

_____e. Production manager

_____f. Technical illustrator

TEST

10. Classify the following careers in audiovisual communication by placing a "C" next to the creative careers, a "T" next to the trade careers, and an "M" next to the management careers.

_____a. Computer service technician

_____b. Actor

_____c. Director

_____d. Camera operator

_____e. Computer programmer

_____f. Radio announcer

_____g. Computer operator

_____h. Personnel manager

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

11. Research a communication device and discuss its possible effect on the future. (Assignment Sheet #1)

12. Send a message in a unique manner. (Assignment Sheet #2)

13. Establish a communication organization to produce a product or service. (Assignment Sheet #3)

14. Research a communication career. (Assignment Sheet #4)

INTRODUCTION TO COMMUNICATION
UNIT I-B

ANSWERS TO TEST

1. a. 1
   b. 7
   c. 3
   d. 5
   e. 2

2. c

3. a. Cave pictures
   b. Letterpress
   c. George Eastman
   d. Telegraph
   e. 1944

4. a. Sender
   b. Channel
   c. Message
   d. Interference
   e. Receiver
   f. Feedback

5. a. Encoding
   b. Transmitting
   c. Receiving
   d. Decoding

6. a. 2
   b. 3
   c. 4
   d. 1

7. a. AV
   b. A
   c. V
   d. V
   e. A
   f. AV
   g. A
   h. V

8. Answers should be evaluated to the satisfaction of the instructor. Student's discussion should include information of a similar nature to the following:
   a. Families experience the impact of communication technology through the stock-market report in the daily newspaper, listening to the latest recording on the radio, or watching the day's events on a television newscast. Buying an advertised product or receiving a telephone call is also an effect of communication.
   b. Governments could not operate today without mass media. Communication serves at all levels of government: local, state, and national. Government leaders and journalists keep us informed through the media.

ANSWERS TO TEST

9.	a.	T
	b.	C
	c.	T
	d.	C
	e.	M
	f.	C
10.	a.	T
	b.	C
	c.	M
	d.	T
	e.	C
	f.	C
	g.	T
	h.	M

11.—14. Evaluated to the satisfaction of the instructor.

DESIGNING MESSAGES
UNIT II-B

UNIT OBJECTIVE

After completion of this unit, the student should be able to apply the elements and principles of design to prepare a preliminary message. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to designing messages with the correct definitions.
2. Arrange in order the steps in designing a message.
3. Match the elements of design with their correct definitions.
4. Complete statements concerning the principles of design.
5. Complete statements concerning methods of designing preliminary messages.
6. Identify elements and principles of design. (Assignment Sheet #1)
7. Improve an advertisement. (Assignment Sheet #2)
8. Design a message. (Assignment Sheet #3)

DESIGNING MESSAGES
UNIT II-B

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

G. Integrate the following activities throughout the teaching of this unit:

1. Plan to use this unit as the preliminary design unit prior to Unit III-B. The exploratory areas you may wish to use are:

   Drafting, printing, photography, reprographics, radio, VCR, and computer-aided design

2. Use Assignment Sheet #2 and #3 to implement the AIASA competitive events Graphic Logo and Safety Poster.

3. Use a resource of advertisements to supplement Assignment Sheet #2. Find ads that are poorly composed, lack unity, and emphasize the wrong points or elements. Use this assignment to point out the importance of correct lettering size, style, and unity.

4. Show advertisements or pictures that illustrate formal or informal balance. Have students discuss how to change from one style to the other.

5. Show examples of award-winning ads and have students discuss why they were selected as outstanding.

6. Develop individual modules for student activities and plan to rotate students through the system. All students cannot work on the same project at one time.

7. Use computer software in the design process. Several programs are listed in the "Suggested Supplemental Resources" on the following page. Many others are being developed and may be available from a local computer center.

8. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

SUGGESTED ACTIVITIES

H. Administer test.

I. Evaluate test.

J. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Jones, Ronald E. and Janet L. Robb. *Discovering Technology Communication.* Dallas, TX: Harcourt Brace Jovanovich Publishers, 1986.

B. Bame, E. Allen and Paul Cumming. *Exploring Technology.* Worcester, MA: Davis Publishing, Inc., 1980.

C. Hauenstein, A. Dean and Steven A. Backmeyer. *The World of Communications: Audiovisual Media.* Bloomington, IL: McKnight Publishing Co., 1975.

D. Kagy, Frederick D. *Graphic Arts.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1981.

E. Walker, John R. *Graphic Arts Fundamentals.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1980.

F. *Graphic Communications.* Iowa High School Industrial Technology Curriculum Project. Iowa Department of Public Instruction,1986.

SUGGESTED SUPPLEMENTAL RESOURCES

Computer Software Programs

A. *Print Shop* — Simple to use. Writes, designs, and prints business cards, letterheads, notices, etc. Teaches layout technique. Has different type styles, borders, and clip art. Available for IBM, Apple II, Macintosh, and Apple family hardware.

B. *Newsroom* — Designs, produces, and prints newspapers. Has a large clip art library. Available for Apple II, Apple family, and IBM hardware.

C. *Computer Eyes II* — Creates real world images by hooking a video camera to a computer and digitizes the picture onto paper. Available for Apple II and IBM hardware.

The above software as well as many others are available from your local computer center, computer magazines, or the following:

Pitsco
Box 1328
Pittsburg, KS 66762
1-800-835-0686

D. MACVision — Video digitizing device which uses a radio signal and converts it to digits so the microcomputer can use or store it. The image can then be printed. Ideal for a type of screen printing. This is available from local software stores.

DESIGNING MESSAGES
UNIT II-B

INFORMATION SHEET

I. **Terms and definitions**

A. Media — Means used for transmitting a message

Examples: Radio, television, photographs, newspapers

B. Format — Specifies the media, style, and arrangement to be used for transmission of a message

C. Decoding — Understanding and responding to a message

D. Encoding — Converting information into a message

E. Transmitting — Transferring or sending a message

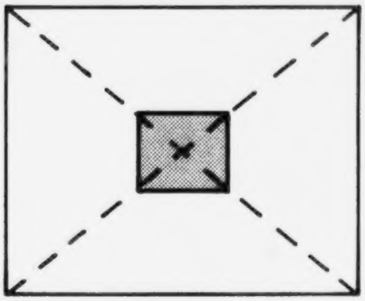
Examples: Gesturing, speaking, writing, touching, drawing

F. Receiving — Coming into possession of a message through seeing, touching, feeling, hearing, smelling, or tasting

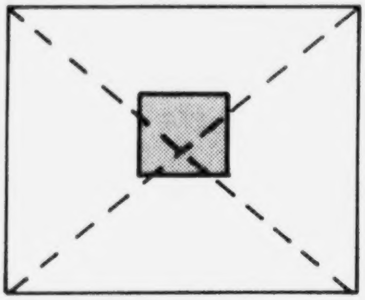
G. Evaluating — A form of feedback to determine significance and worth

H. Comprehensive layout — A full size, completed design of the finished product

I. Optical center — A point slightly above the true center; more visually pleasing



True Center



Optical Center

INFORMATION SHEET

II. **Steps in designing a message**

A. State the objective (problem) — Decide what is to be designed or transmitted and state the problem as clearly and specifically as possible.

(NOTE: Answer the who, what, where, when, and how questions at this time.)

B. Gather information — Research the problem by reading, discussing, and thinking about it.

C. Find solutions — Think of all the bits of information you have gathered and decide the best way to solve the problem.

D. Examine solutions — Decide on the best possible solution; then reexamine the solution possibilities.

(NOTE: Decide if it is a cost-effective solution.)

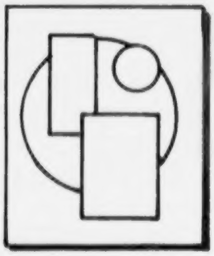
E. Refine ideas — Prepare sketches or script for message.

III. **Elements of design**

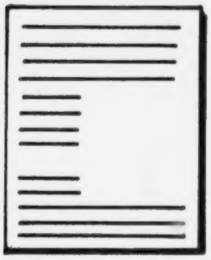
A. Space — The area allowed to work with

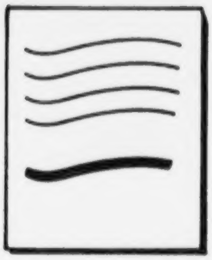
Examples: Piece of paper, billboard, package label

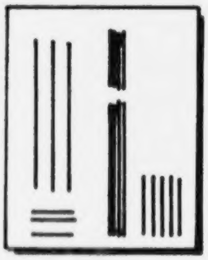
(NOTE: Space for audiovisual design could be a commercial, television program, or a play.)

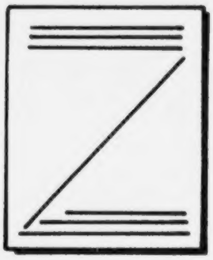


B. Line — Moves the reader's eye from one point to another; may be straight, curved, angled, heavy, or light



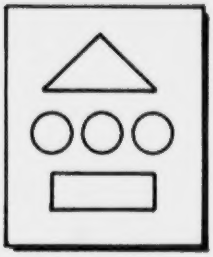






INFORMATION SHEET

C. Form — Gives an element shape; may be a square, rectangle, circle, triangle, or irregular shape



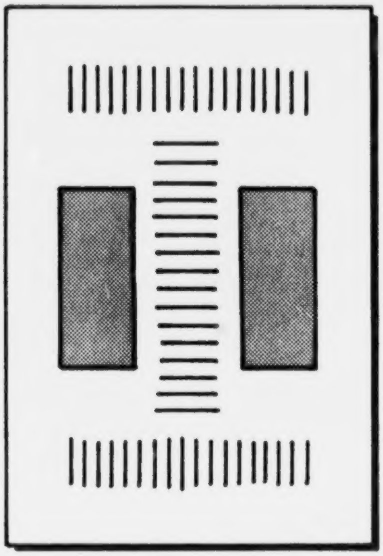
D. Color — Attracts the eye and provides contrast as well as sets the mood of a design

(NOTE: Red, yellow, and orange are warm colors. These colors seem to jump out from the page. Blue, green, and purple are cool colors. These colors seem to recede into the page. Dark colors make objects appear smaller. Light colors make objects appear larger.)

IV. **Principles of visual design**

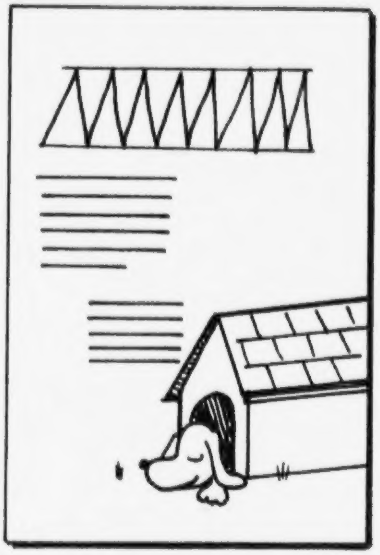
A. Balance — Distribution of weight on each side of a center point; may be formal or informal. (Transparency 1)

1. Formal balance — Symmetrical; achieved by identical or even placement on each side of the center point.

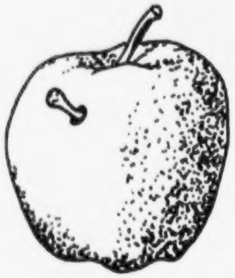


INFORMATION SHEET

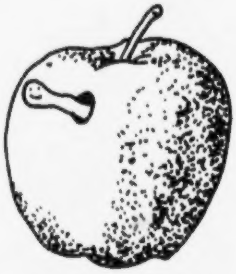
2. Informal balance — Asymmetrical; achieved by equalizing the weight of different elements in a design. A smaller element placed farther away from the central point can balance a larger element which is closer to the center.



B. Proportion — Relationship between the sizes of the elements of the design.



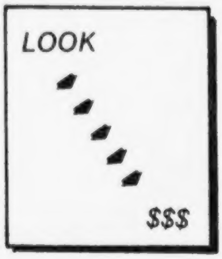
Out of Proportion



In Proportion

C. Rhythm — Directs and controls the motion of the reader's eye.

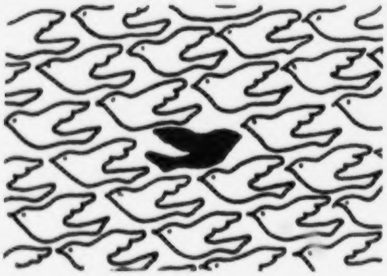
Example:



INFORMATION SHEET

D. Contrast or emphasis — Used to create interest and attract attention by using differences in size, color, or appearance.

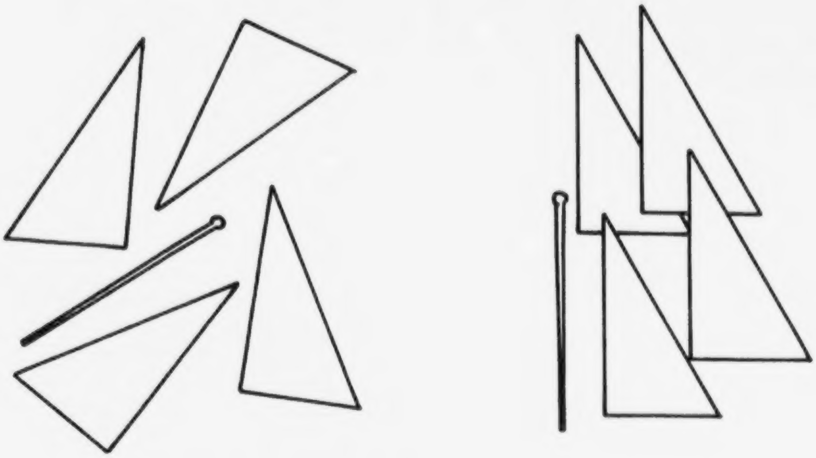
Examples:



JOE'S TOWING
OPEN
24 HOURS

E. Unity — A combination of different elements to promote an undivided total effect. Similar forms or typefaces are commonly used in a design to promote unity.

Example:



(NOTE: The pile of elements on the left have been arranged randomly, but if they are placed as shown on the right, they seem to belong together.)

V. **Methods of designing preliminary messages**

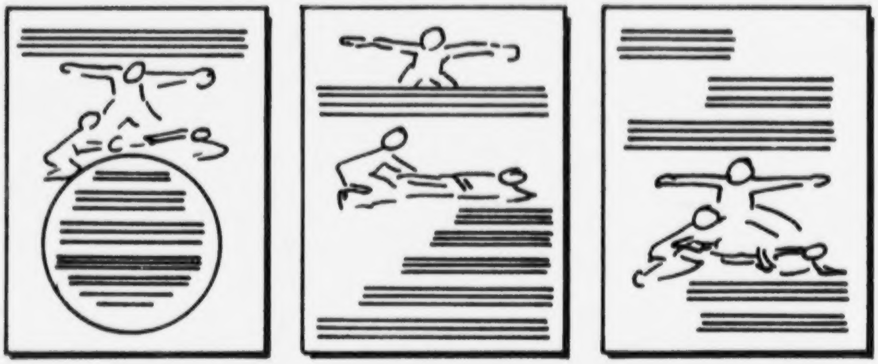
A. Visual designing (Transparency 2)

1. Thumbnail sketch — A small freehand sketch made quickly to show design ideas. Usually the sketch is smaller than final layout, but is in approximately the same proportion.

   (NOTE: Usually more than one thumbnail is done at one time to show different ideas.)

INFORMATION SHEET

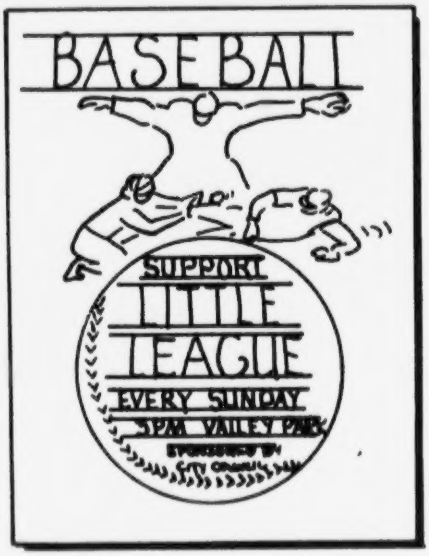
Example:



2. Rough sketch — A full size detailed sketch of a thumbnail

(NOTE: The rough is usually a clearer representation of the design. The rough sketch will later be used to make a comprehensive layout.)

Example:


BASEBALL
SUPPORT
LITTLE
LEAGUE
EVERY SUNDAY
5PM VALLEY PARK
SPONSORED BY
CITY COUNCIL

INFORMATION SHEET

B. Audio and audiovisual designing (Transparencies 3-5)

1. Storyboard — Outlines the program's action with both pictures and written descriptions.

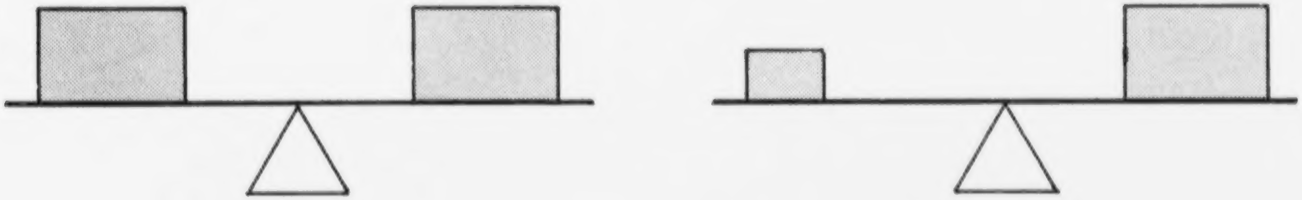
   (NOTE: A storyboard allows the writer to rearrange the sequence of events if necessary. The storyboard is the basis for developing scripts.)

2. Audio script — A script of everything that is to be heard

   Examples: Dialogue, music, sound effects, commercials

3. Production script — A script for television, movies, or theater productions including all directions of performers' dialogue and techniques, technical crew instructions, scenery and props needed, and lighting, camera, and sound instructions.

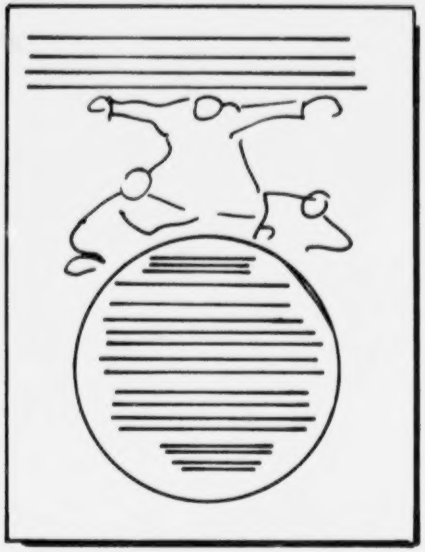
Balance


Formal
Informal

The distribution of weight on each side of a center point

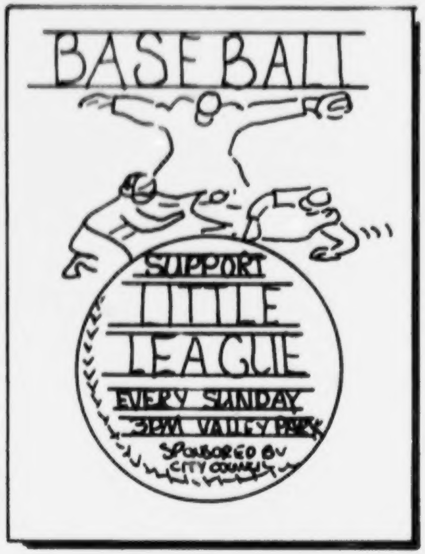
Designing a Message

Step 1



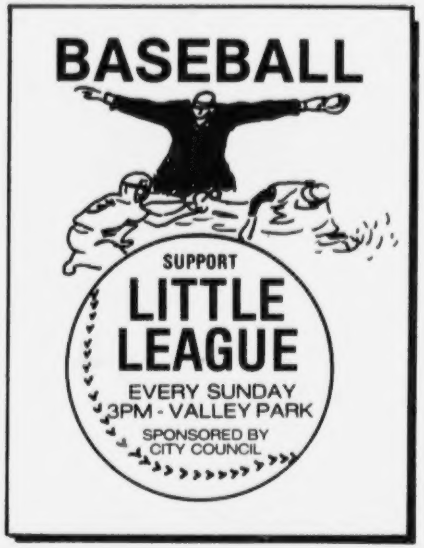
Thumbnail Sketch

Step 2


BASEBALL
SUPPORT
LITTLE
LEAGUE
EVERY SUNDAY
3PM VALLEY PARK
SPONSORED BY
CITY COUNCIL

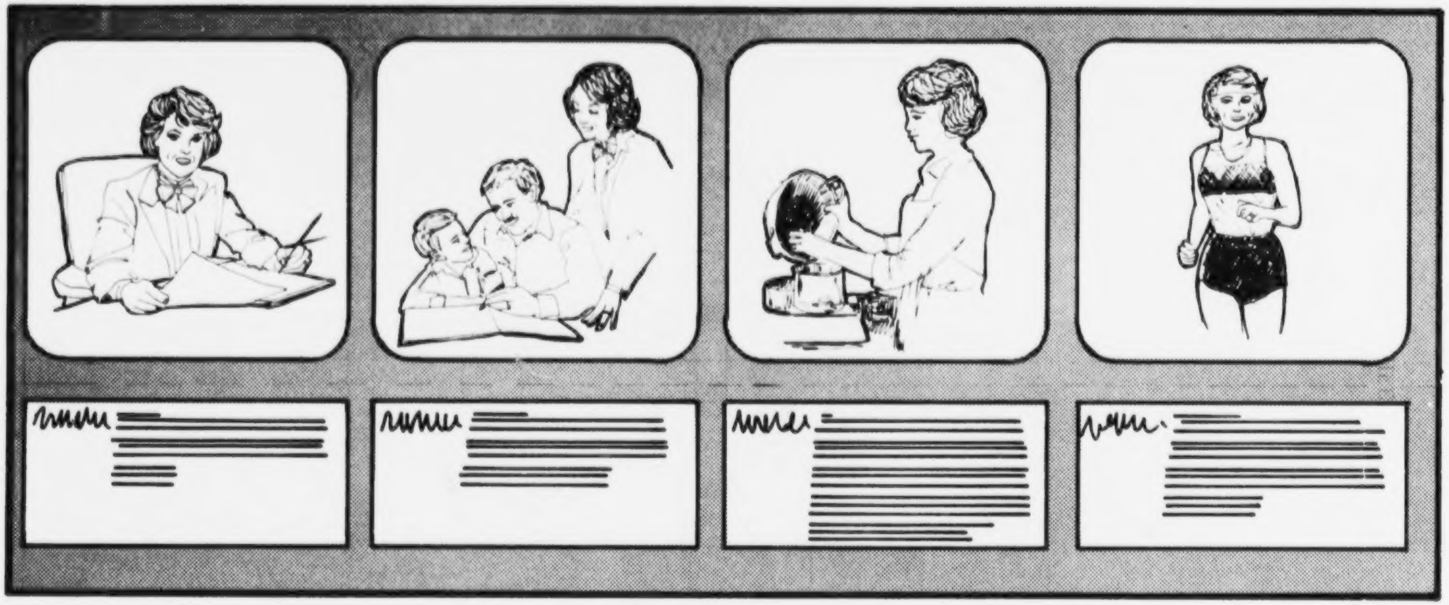
Rough Sketch

Step 3


BASEBALL
SUPPORT
LITTLE
LEAGUE
EVERY SUNDAY
3PM - VALLEY PARK
SPONSORED BY
CITY COUNCIL

Comprehensive Layout

Storyboard



A storyboard shows both the written descriptions and illustrations of the action.

Audio Script

WHEN A MAN MURDERS . . . PART FOUR
DATE: Wednesday, December, 10, 1986
TIME: 4:00 — 5:00 p.m.

WOLFE: Archie! Archie!

SOUND: *Man's footsteps entering room.*

WOLFE: Get Mr. Cramer.

SOUND: *Man picking up phone and dialing.*

ARCHIE: This is Archie Goodwin calling for Nero Wolfe. Mr. Wolfe needs to speak to Mr. Cramer . . . It's very important . . . God only knows what tomorrow's papers will say if Mr. Wolfe doesn't get to speak to Cramer immediately!

SOUND: *Another phone is picked up.*

CRAMER: (gruffly) Goodwin! Is Wolfe on?!

SOUND: *Another phone is picked up.*

WOLFE: Mr. Cramer? I don't know if you know that I'm investigating the Karnow murder. For a client. Mrs. Karnow engaged me at noon today.

CRAMER: Go ahead and investigate. What do you want?

WOLFE: I understand that Mr. Aubrey is being held on a murder charge, without bail. That's regrettable, because he's innocent. If you are supporting that charge, I advise you to reconsider. On the soundness of that advice I stake my professional reputation.

CRAMER: (Sarcastically) That's all I wanted, your advice. Is it all right if I wait till morning to turn him loose?

WOLFE: Formalities may require it. May I ask a question? How many of the others — Mrs. Savage, her son, Mr. and Mrs. Horne, Mr. Beebe — have been eliminated by alibis?

CRAMER: Crossed off, no one. But Aubrey not only has no alibi, he admits he was there.

WOLFE: Yes, I know. However, it was one of the others. I must now choose between alternatives. Either I proceed independently to disclose and hand over the culprit, or I invite you to partake. Which would you prefer?

Production Script

The Glass Menagerie
Scene 5

Legend on Screen: "Annunciation." *Fade with music. (It is early dusk of a spring evening. Supper has just been finished in the Wingfield apartment.* AMANDA *and* LAURA *in light colored dresses are removing dishes from the table, in the upstage area, which is shadowy, their movements formalized almost as a dance or ritual, their moving forms as pale and silent as moths.*

TOM, *in white shirt and trousers, rises from the table and crosses toward the fire escape.*

AMANDA *(as he passes her)*: Son, will you do me a favor?

TOM: What?

AMANDA: Comb your hair! You look so pretty when your hair is combed! (TOM *slouches on sofa with evening paper. Enormous caption "Franco Triumphs.")* There is only one respect in which I would like you to emulate your father.

TOM: What respect is that?

AMANDA: The care he always took of his appearance. He never allowed himself to look untidy. *(He throws down the paper and crosses to fire-escape.)* Where are you going?

TOM: I'm going out to smoke.

AMANDA: You smoke too much. A pack a day at fifteen cents a pack. How much would that amount to in a month? Thirty times fifteen is how much, Tom? Figure it out and you will be astounded at what you could save. Enough to give you a night-school course in accounting at Washington U! Just think what a wonderful thing that would be for you, son!

(TOM *is unmoved by the thought.*)

TOM: I'd rather smoke. *(He steps out on landing, letting the screen door slam.)*

AMANDA *(sharply)*: I know! That's the tragedy of it . . . *(Alone, she turns to look at her husband's picture.)*

(DANCE MUSIC: "ALL THE WORLD IS WAITING FOR THE SUNRISE")

DESIGNING MESSAGES
UNIT II-B

ASSIGNMENT SHEET #1 — IDENTIFY ELEMENTS AND PRINCIPLES OF DESIGN

NAME ________________________________ SCORE ____________

Directions: Collect advertisements from newspapers or magazines that illustrate the following:

Elements	**Principles**
Space	Balance (formal or informal)
Line	Proportion
Form	Rhythm
Color	Contrast or emphasis
	Unity

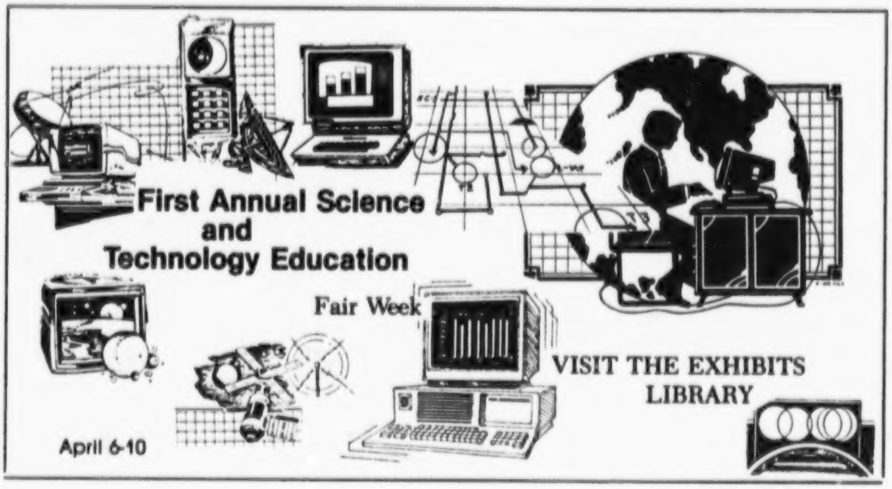
Describe parts of the ads which show the various elements and principles of design. Attach your descriptions to the ad and turn in to your instructor.

DESIGNING MESSAGES
UNIT II-B

ASSIGNMENT SHEET #2 — IMPROVE AN ADVERTISEMENT

NAME ______________________________ SCORE __________

Directions: Shown below is an advertisement that will be used in the school newspaper. List ways to improve it or redesign the ad on the back of this page. Remember the elements and principles of design as you add those improvements.



First Annual Science and Technology Education

Fair Week

VISIT THE EXHIBITS LIBRARY

April 6-10

Ways to improve ad

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DESIGNING MESSAGES
UNIT II-B

ASSIGNMENT SHEET #3 — DESIGN A MESSAGE

NAME ______________________________ SCORE __________

(NOTE: This assignment should be in accordance with the project selected in Unit I-B, Assignment Sheet #3.)

Directions: Plan a message that will help you to sell your product or service.

Examples: A visual or audiovisual advertisement
A package or logo

Use the methods of designing preliminary messages and prepare the rough sketch or storyboard and script needed to show your idea.

DESIGNING MESSAGES
UNIT II-B

NAME ______________________ SCORE ____________________

TEST

1. Match the terms on the right with their correct definitions.

_____a. Understanding and responding to a message

_____b. Transferring or sending a message

_____c. Coming into possession of a message through seeing, touching, feeling, hearing, smelling, or tasting

_____d. Means used for transmitting a message

_____e. Specifies the media, style, and arrangement to be used for transmission of a message

_____f. A form of feedback to determine significance and worth

_____g. A full size, completed design of the finished product

_____h. Converting of information into a message

_____i. A point slightly above the true center

1. Evaluating
2. Optical center
3. Transmitting
4. Receiving
5. Encoding
6. Decoding
7. Golden center
8. Media
9. Comprehensive layout
10. Rough sketch
11. Format
12. Television

2. Arrange in order the following steps used in designing a message by placing the correct sequence numbers (1-5) in the appropriate blanks.

_____a. Refine ideas — Prepare sketches or script for message.

_____b. State the objective (problem) — Decide what is to be designed or transmitted and state the problem as clearly and specifically as possible.

_____c. Examine solutions — Decide on the best possible solution; then reexamine the solution possibilities.

_____d. Gather information — Research the problem by reading, discussing, and thinking about it.

_____e. Find solutions — Think of all the bits of information you have gathered and decide the best way to solve the problem.

TEST

3. Match the elements of design on the right with their correct definitions.

_____a. Moves the reader's eye from one point to another; may be straight, curved, angled, heavy, or light

_____b. Attracts the eye and provides contrast as well as sets the mood of the design

_____c. Gives an element shape; may be a square, rectangle, circle, triangle, or irregular shape

_____d. The area allowed to work with

1. Color
2. Space
3. Contrast
4. Form
5. Line

4. Complete the following statements concerning the principles of design by circling the correct words.

   a. The relationship between the sizes of the elements of the design is (**color, balance, proportion**).

   b. (**Contrast, Rhythm**) directs and controls the motion of the reader's eye.

   c. A combination of different elements to promote an undivided total effect is (**unity, color**).

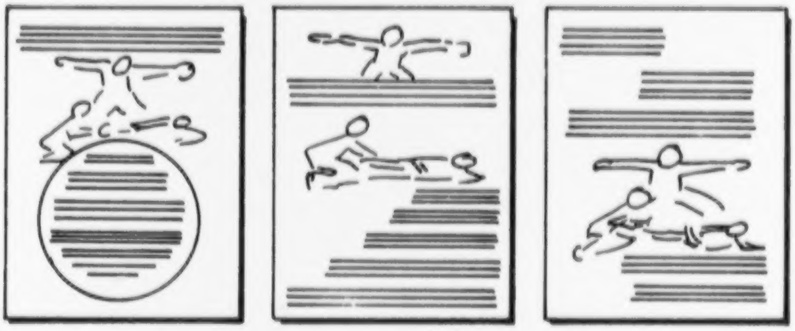
   d. (**Contrast, Balance**) is used to create interest and attract attention by using differences in size, color, or appearance.

   e. Distribution of weight on each side of a center point is (**emphasis, balance**).

5. Complete the following statements concerning the methods of designing preliminary messages by circling the correct words.

   a. Outlines the program's action with both pictures and written descriptions — (**rough sketch, storyboard, audioscript**).

   b. The figures below are (**rough sketches, thumbnail sketches, scripts**).

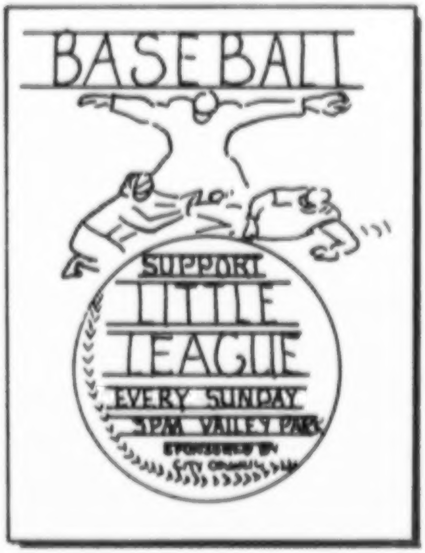


TEST

c. A script of everything to be heard is a(n) **(audio, visual)** script.

d. A television or movie script that includes all directions is a(n) **(rough, audio, production)** script.

e. The following sketch shows more details of previous small sketches. It is called **(rough sketch, thumbnail sketch, comprehensive sketch)**.


BASEBALL
SUPPORT
LITTLE
LEAGUE
EVERY SUNDAY
3PM VALLEY PARK
SPONSORED BY
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(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

6. Identify elements and principles of design. (Assignment Sheet #1)

7. Improve an advertisement. (Assignment Sheet #2)

8. Design a message. (Assignment Sheet #3)

DESIGNING MESSAGES
UNIT II-B

ANSWERS TO TEST

1. a. 6
   b. 3
   c. 4
   d. 8
   e. 11
   f. 1
   g. 9
   h. 5
   i. 2

2. a. 5
   b. 1
   c. 4
   d. 2
   e. 3

3. a. 5
   b. 1
   c. 4
   d. 2

4. a. Proportion
   b. Rhythm
   c. Unity
   d. Contrast
   e. Balance

5. a. Storyboard
   b. Thumbnail sketches
   c. Audio script
   d. Production
   e. Rough sketch

6.-8. Evaluated to the satisfaction of the instructor

PRODUCING MESSAGES
UNIT III-B

UNIT OBJECTIVE

After completion of this unit, the student should be able to apply techniques of message production to prepare a message. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to producing messages with the correct definitions.
2. Complete statements concerning the methods of producing visual messages.
3. Match means of transmitting audio-audiovisual messages with the correct descriptions.
4. Complete statements concerning emerging communications transmission technologies.
5. Identify basic drafting tools and equipment.
6. Read units of measure.
7. Identify the alphabet of lines.
8. Select true statements concerning orthographic projection views.
9. Arrange in order the steps in developing an orthographic drawing.
10. Prepare an oral presentation. (Assignment Sheet #1)
11. Make an oral presentation. (Assignment Sheet #2)

OBJECTIVE SHEET

12. Prepare a comprehensive layout. (Assignment Sheet #3)
13. Complete a graphic design. (Assignment Sheet #4)
14. Practice reading units of measure. (Assignment Sheet #5)
15. Complete a three-view orthographic drawing. (Assignment Sheet #6)

PRODUCING MESSAGES
UNIT III-B

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Plan to use this unit to refine message designs initiated in Unit II-B.
2. Use Assignment Sheets #3 and #4 to refine graphic logo or safety poster designs.
3. Stress laboratory safety in all areas of activity.
4. Plan to videotape the students' presentations.
5. Demonstrate the use of your CAD system, its hardware, software, and the types of drawings it can produce. Show samples of drawings made by both your CAD system and other more sophisticated systems.
6. Develop individual modules for teaching your CAD system.
7. Demonstrate the procedure for digitizing visual images. Software packages are available from your local computer stores. Recommended resources were listed in previous units.
8. Demonstrate the use of a precision drawing system template. Refer to suggested supplemental resources for address.
9. Discuss the progression of drafting from manual instruments to machines to CAD and the increase of speed along the way.
10. Demonstrate the orthographic projection concept using a clear cube container or other cube-type container.

SUGGESTED ACTIVITIES

11. Refer to the next unit (Unit IV-B) for criteria on evaluating messages.
12. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Administer test.

I. Evaluate test.

J. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Scott, Raymond C., Ronald L. Foy, and Mark Schwendan. *Drafting Fundamentals.* Peoria, IL: Bennett McKnight Publishing Co., 1985.

B. Jones, Ronald E. and Janet L. Robb. *Discovering Technology Communication.* Dallas, TX: Harcourt Brace Jovanovich Publishers, 1986.

C. Bame, E. Allen and Paul Cummings. *Exploring Technology.* Worcester, MA: Davis Publishing, Inc., 1980.

D. Hauenstein, A. Dean and Steven A. Bachmeyer. *The World of Communication: Audiovisual Media.* Bloomington, IL: McKnight Publishing Co., 1975.

E. Kagy, Frederick D. *Graphic Arts.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1981

F. Walker, John R. *Graphic Arts Fundamentals.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1980.

G. Miller, Wilbur R., et. al. *Drafting.* Bloomington, IL: McKnight Publishing Co., 1978.

H. Feirer, John L. and John R. Linbeck. *Basic Drafting.* Peoria, IL: Chas. A. Bennett Co., Inc., 1978.

I. *Graphic Communications.* Iowa High School Industrial Technology Curriculum Project. Iowa Department of Public Instruction, 1986.

SUGGESTED SUPPLEMENTAL RESOURCES

A. Precision Drawing System — Useful drafting tool that replaces several conventional tools. Several scales are available from:

InterMark Enterprises
610 West Broadway, Suite 213
Tempe, Arizona 85282

SUGGESTED SUPPLEMENTAL RESOURCES

B. *Stepping into CAD* — A technical drafting program using the Auto CAD™ microcomputer program. Available from:

Autodesk, Inc.
2320 Martinship Way
Sausalito, CA 94965

C. Supplies for a simplified method of screen printing that uses a thermal copier to produce screens. Available from:

Welsh Products, Inc.
1201 East 5th Street, P.O. Box 845
Benicia, CA 94510
(707) 745-3252 or 554-3222

D. *Lines and Views* — A guide for teaching grid drafting and the coordinate system. Available from:

Nelson Parke
805 South Devonshire
Springfield, MO 65802

PRODUCING MESSAGES
UNIT III-B

INFORMATION SHEET

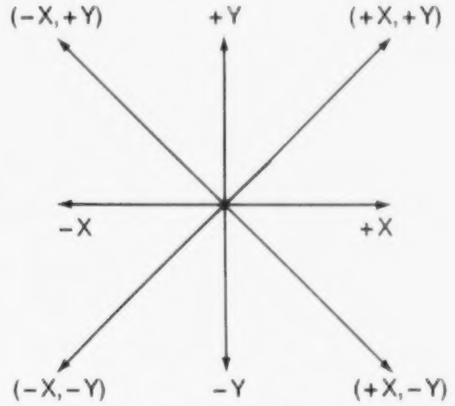
I. **Terms and definitions**

A. Computer-aided drafting (CAD) and computer-aided drafting and design (CADD) — Using a computer to create or modify designs and drawings

B. Coordinates — Set of numbers that locate a point on a line, on a surface (plane), or in space

(NOTE: Cartesian coordinates use two or three intersecting straight-line axes. Coordinates are especially helpful when working on a CAD system.)

FIGURE 1



Coordinates

C. Electronic desktop publishing — Using a computer and appropriate software to layout, typeset, and print publications

(NOTE: The hardware components for these systems are usually small enough to be set up on a desk.)

D. Scale drawing — A drawing that is made larger or smaller than the original object

E. Videocassette recorder (VCR) — An electronic device used to record and playback from a videotape the broadcast received by a television set

F. Videodisk — A record-like disk that records both audio and video (visual) information

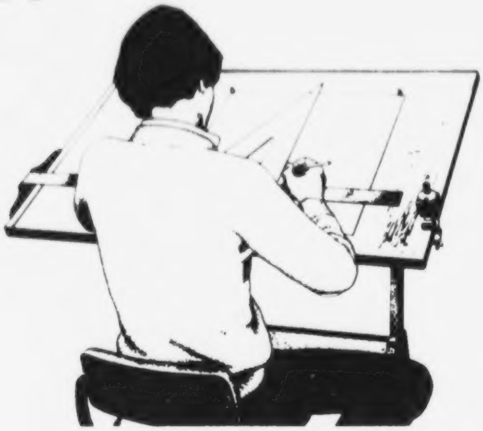
INFORMATION SHEET

II. Methods of producing visual messages

A. Drafting — The universal language of industry and modern technology. It is used to communicate ideas and specific information. Several methods may be used.

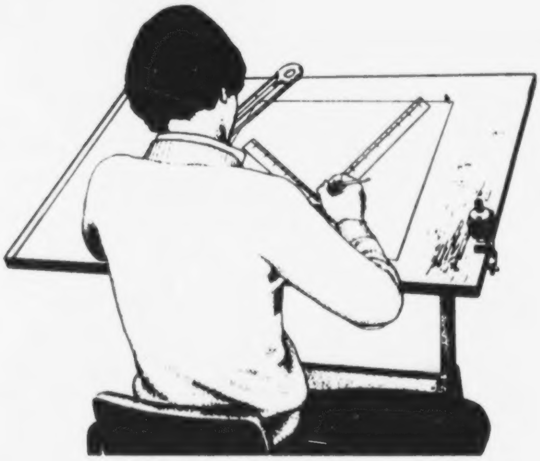
1. Manual drafting — Uses traditional tools such as triangles, T-squares, and protractors.

FIGURE 2



2. Machine drafting — Uses a drafting machine which replaces T-squares, triangles, protractors, and hand-held scales. Drafter still uses pens and pencils to draw.

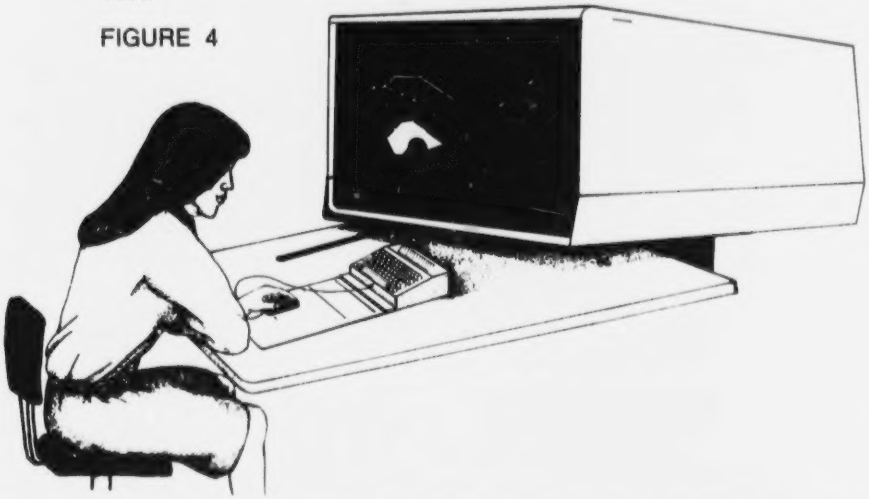
FIGURE 3



INFORMATION SHEET

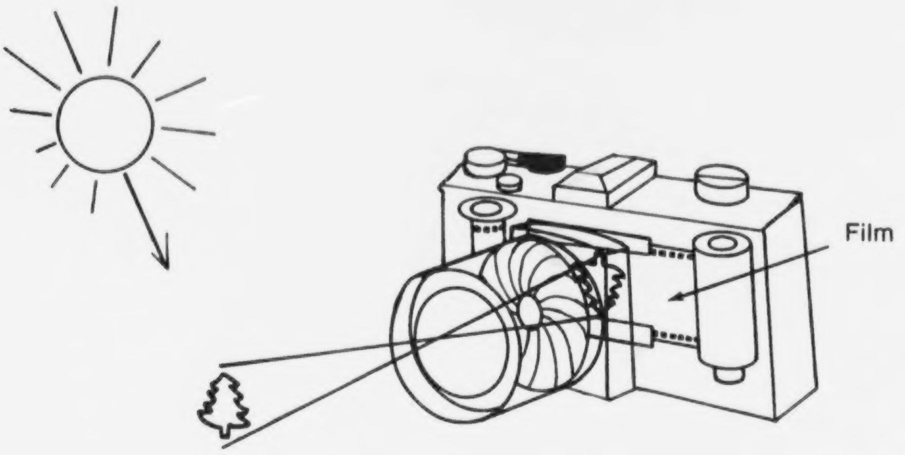
3. Computer-aided drafting (CAD) — Uses computer hardware and software

FIGURE 4



B. Photography — The process of producing images on a sensitized surface (film) by the action of radiant energy. Exposed film is processed to produce a negative; then prints are made from the negatives using a photographic enlarger in a darkroom.

FIGURE 5

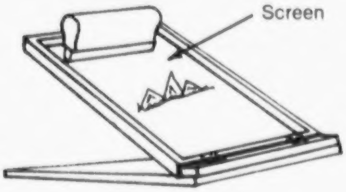


INFORMATION SHEET

C. Screen printing — A form of stencil printing where the ink is passed through a design on a screen. The stencil or image is made from a special film which is then put on a screen. The ink passes only through holes in the screen where there is no film.

(NOTE: This is an excellent way to produce special design T-shirts.)

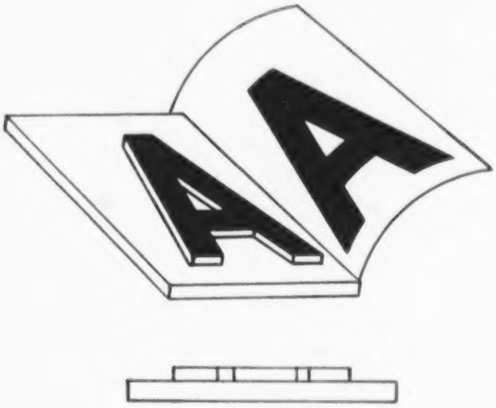
FIGURE 6



D. Relief printing (letterpress) — A method of printing from a raised surface. The surface of the image is raised and inked. The image is transferred when the paper is pressed against the raised surface.

(NOTE: Messages are reversed on the letterpress image carrier. When printed, the message will read correctly.)

FIGURE 7



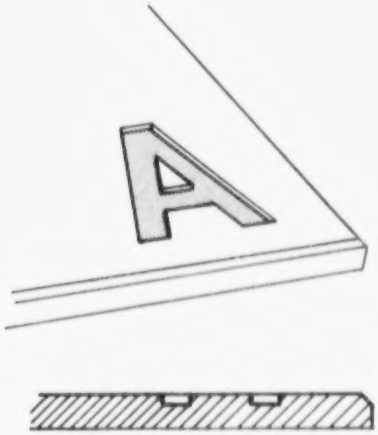
Raised Printing Surface

INFORMATION SHEET

E. Gravure printing (intaglio) — A printing process where the recessed image area is made by engraving, etching, or scratching

(NOTE: Photography and a chemical process are often used to make the recessed image area. Paper money, stamps, and special catalogs are produced by this method.)

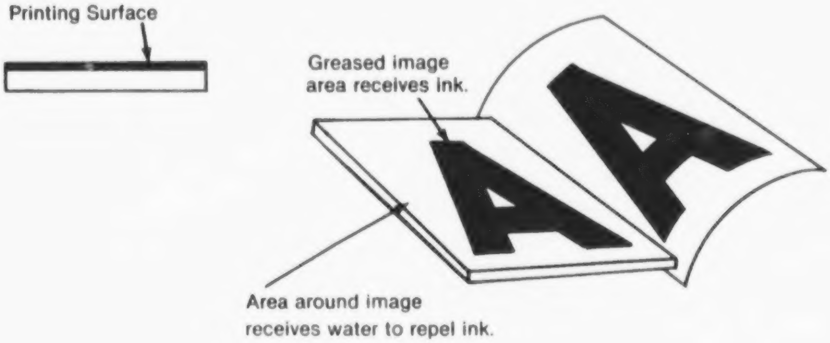
FIGURE 8



Depressed Printing Surface

F. Offset printing (lithography) — So named because the image is first received by a blanket and transfers to the sheet to be printed. Based on the principle that oil and water do not readily mix.

FIGURE 9


Printing Surface
Greased image area receives ink.
Area around image receives water to repel ink.

(NOTE: In addition to printing, many visual images may be reproduced by electrostatic copying such as by a Xerox copier.)

INFORMATION SHEET

III. Means of transmitting audio-audiovisual messages

A. Telephone — An audio communication system that converts sound into electrical impulses for transmission primarily by wire.

(NOTE: Telephone companies have been major contributors in the development of laser, microwave, satellite, and fiberoptic transmission methods. These new methods provide higher-quality, lower-cost long-distance transmission of signals.)

B. Radio — An audio communication system that converts sound into electrical impulses for wireless transmission by means of electromagnetic waves.

C. Television — A complex communication system using cameras, microphones, monitors, controls, and computers to record and transmit audio **and** video messages.

(NOTE: Television signals are transmitted in two ways, broadcast and cable television.)

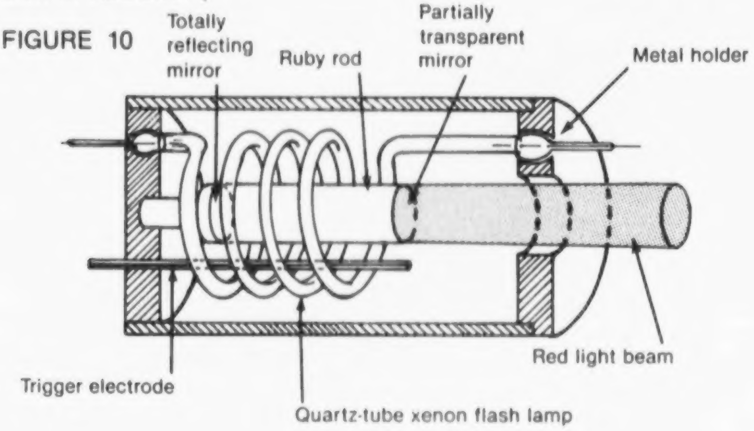
D. Computer — An electronic device used to store, retrieve, and process information (data). Can be used to organize, manipulate, and transmit audio and video messages.

IV. Emerging communication transmission technologies

A. Lasers — Transmit signals (or messages) through the atmosphere using coherent electromagnetic radiation; do not use mechanical devices, fluids, or electrical wires.

(NOTE: The word laser comes from **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation.)

FIGURE 10

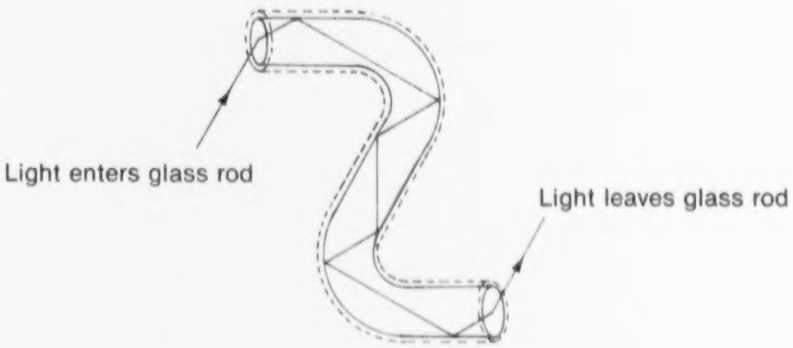

Totally reflecting mirror
Ruby rod
Partially transparent mirror
Metal holder
Red light beam
Trigger electrode
Quartz-tube xenon flash lamp

INFORMATION SHEET

B. Fiberoptics — Transmit light through thin transparent fibers of glass or plastic.

(NOTE: Cables made up of these fiberoptic strands are being used more commonly by telephone companies because they take less space than traditional copper cables and also carry a greater number and better quality of calls.)

FIGURE 11



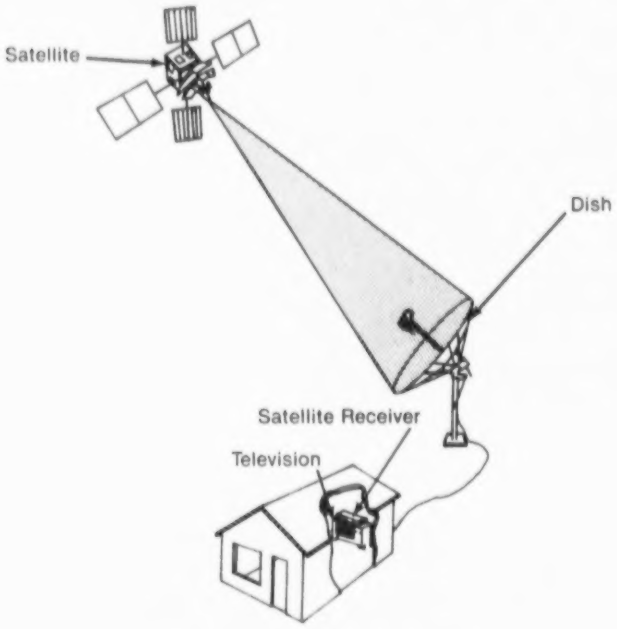
Light Transmitted by Internal Reflection

C. Microwaves — Wireless method of sending signals over a long distance using short electromagnetic waves (microwaves).

INFORMATION SHEET

D. Satellites — Man-made objects that orbit the earth that are used by telephone and television networks to receive and transmit audio and video messages over great distances. A satellite dish is required to receive the signals.

FIGURE 12



V. **Basic drafting tools and equipment** (Transparencies 1-4)

A. Manual drafting tools and equipment (Transparencies 1 and 2)

1. T-square or parallel bar
2. Triangles
3. Protractor
4. Compass
5. Scales
6. Pencils

   (NOTE: These may be wooden or mechanical and come in many degrees of hardness.)

7. Erasers

INFORMATION SHEET

8. Drafting media

    Examples: Drawing paper, vellum, polyester film

B. Machine drafting equipment (Transparency 3)

1. Arm-type drafting machine
2. Track-type drafting machine

C. Computer-aided drafting (CAD) equipment (hardware) (Transparency 4)

(NOTE: A CAD system has three essential features: people who use the system, the hardware, and the software.)

1. Input devices

    Examples: Digitizers, graphic tablet, light pen, function keyboard

2. Information processing unit (IPU)

    Examples: Mainframe, minicomputer, microcomputer, terminal to mainframe

3. Memory recording and storage devices

    Examples: Floppy disk drive, hard disk drive, magnetic tapes

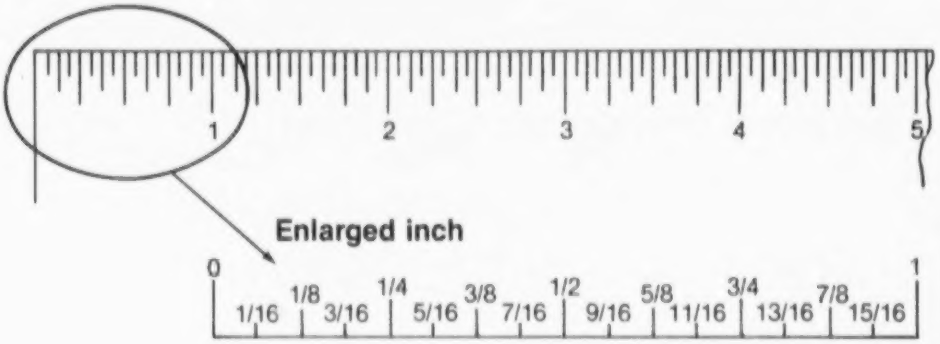
4. Output devices

    Examples: Plotter, printer, CRT (for immediate visual output), photographic equipment

VI. Reading units of measure

A. U.S. customary system — In this system the scale is divided into 1/16, 1/8, 1/4, 1/2, and full inch divisions.

FIGURE 13

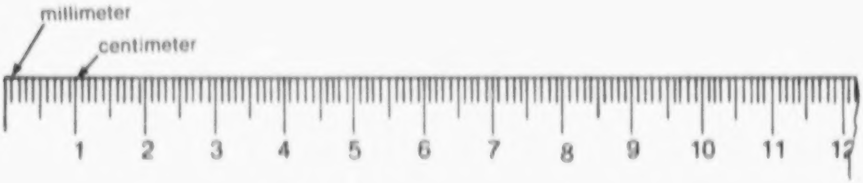


INFORMATION SHEET

B. International system of metric measurement (SI metrics) — In this system the scale is divided into millimeters and centimeters.

(NOTE: Ten millimeters equal one centimeter.)

FIGURE 14

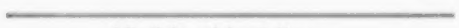


(NOTE: The SI metric system will be the one most commonly used in future years. You should learn to read both U.S. customary and SI metric scales to measure lengths.)

VII. Alphabet of lines (Transparency 5)

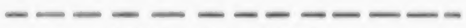
A. Thick lines

1. Visible object line



Visible object line

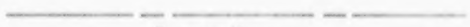
2. Hidden object line



Hidden object line

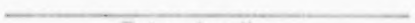
B. Thin lines

1. Center line



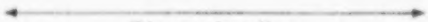
Center line

2. Extension line



Extension line

3. Dimension line



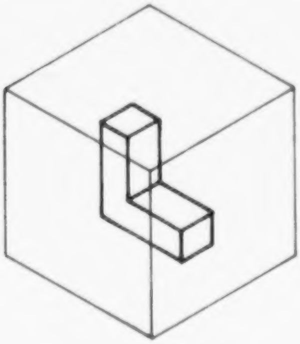
Dimension line

INFORMATION SHEET

VIII. Orthographic projection views

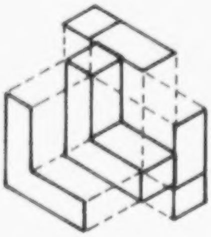
A. The system used to establish and arrange the different views of a drawing is an orthographic projection. Imagine an object inside a glass box.

FIGURE 15



B. Project the surfaces of the object onto the sides of the box.

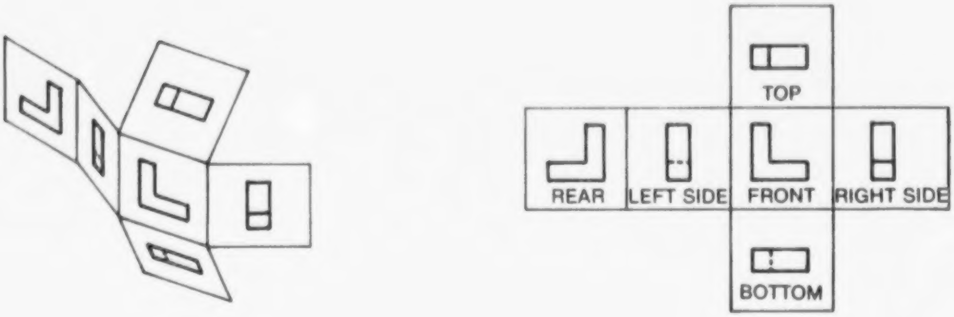
FIGURE 16



INFORMATION SHEET

C. Unfold the glass box and lay it flat. You can now see all six sides.

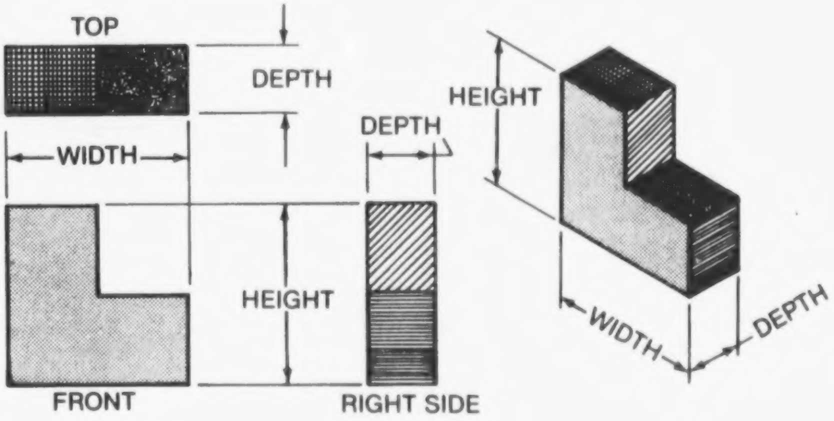
FIGURE 17


TOP
REAR
LEFT SIDE
FRONT
RIGHT SIDE
BOTTOM

(NOTE: Although six sides are possible, only three are commonly used in multiview drawing.)

D. Choose the principal views that show the width, height, and depth of the object. These views will usually be the front, top, and right side.

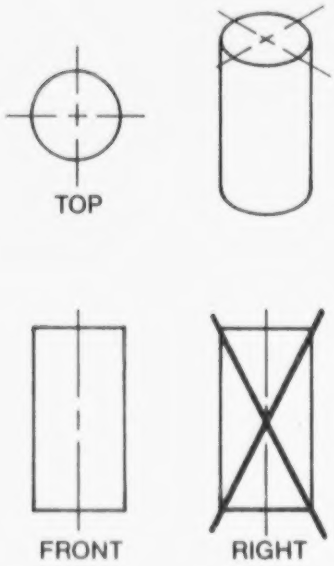
FIGURE 18


TOP
DEPTH
WIDTH
DEPTH
HEIGHT
HEIGHT
FRONT
RIGHT SIDE
WIDTH
DEPTH

INFORMATION SHEET

(NOTE: Some objects do not need three views to supply the necessary information. A cylindrical object, for example, needs only two views. See Figure 19.)

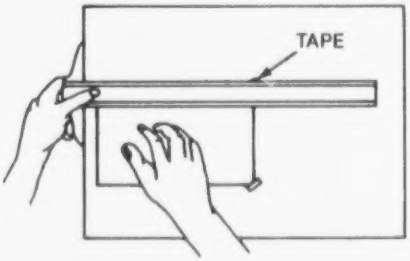
FIGURE 19



IX. Steps in developing an orthographic drawing

A. Align and secure paper carefully to drawing surface.

FIGURE 20



B. Prepare border as directed by instructor.

INFORMATION SHEET

C. Select views to be illustrated.

(NOTE: The front view is the primary view. It is the view that will best show the shape of the object. It may not be the *actual* front view. Select the side view that best shows the object's shape. If a third view or more is needed, select those views.)

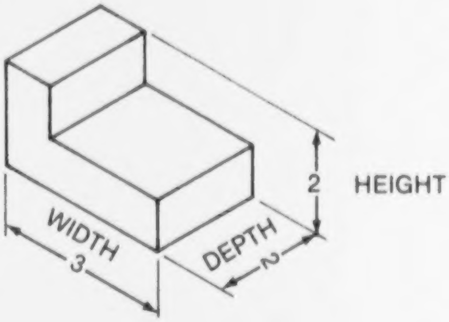
D. Space the views in the drawing space.

(NOTE: A properly scaled drawing will not appear crowded.)

1. Measure the width, depth, and height of the object to be drawn in a three-view drawing.

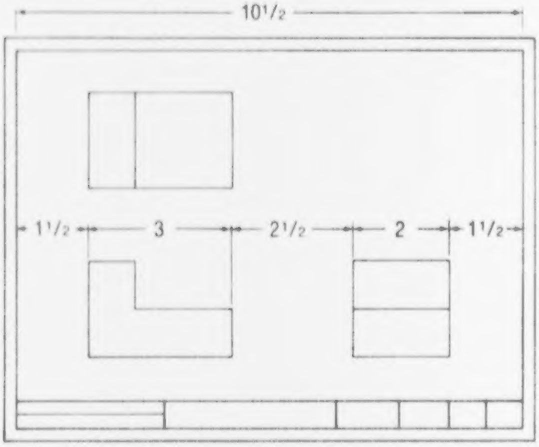
   (NOTE: Determine the scale to be used. For the first drawing, the scale should be full.)

   FIGURE 21



2. Add the width and depth of the object. Subtract this total from the width of your paper. Then divide this remainder into three values. Set the value between the views to be the largest. Set the values between the outside lines of each view and the border lines to be equal to each other.

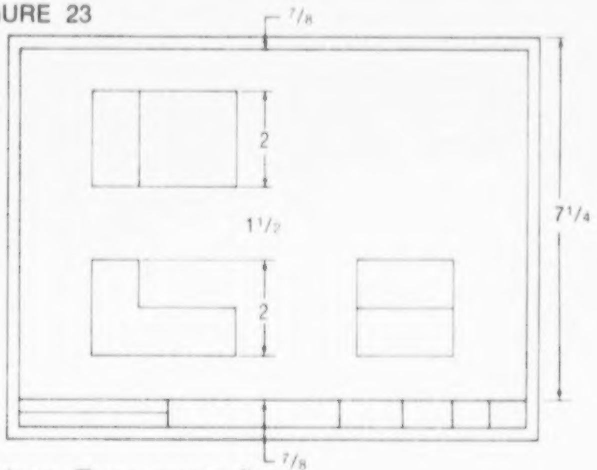
   FIGURE 22



INFORMATION SHEET

3. Follow the same procedure for the vertical spacing using the height and depth dimensions.

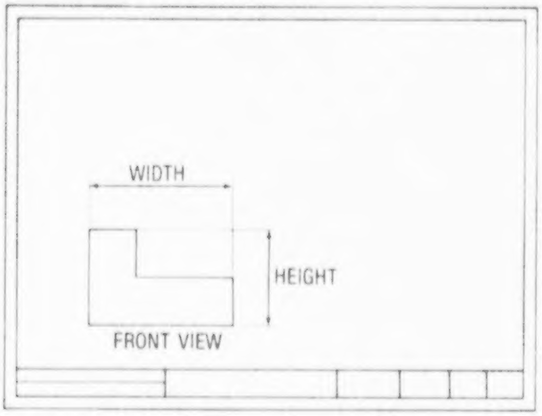
FIGURE 23


7/8
2
$1\frac{1}{2}$
2
$7\frac{1}{4}$
7/8

E. Draw the views. (Transparency 6)

1. Use your drawing instruments to lightly block in the width and height of the front view of the object with light construction lines.

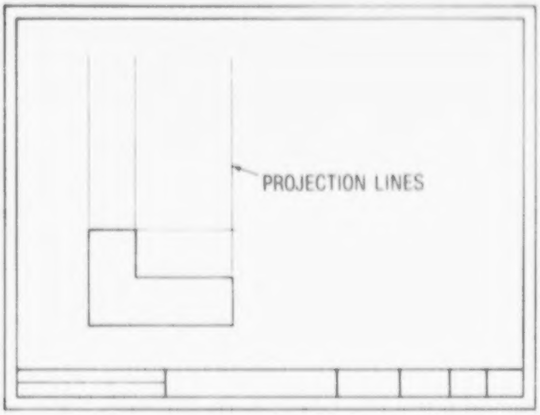
FIGURE 24


WIDTH
HEIGHT
FRONT VIEW

INFORMATION SHEET

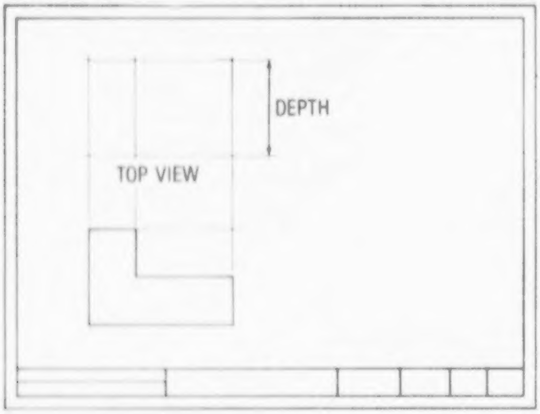
2. Draw vertical projection lines from the width of the front view to the working area for the top view.

FIGURE 25


PROJECTION LINES

3. Lightly block in the depth dimension to locate the top view.

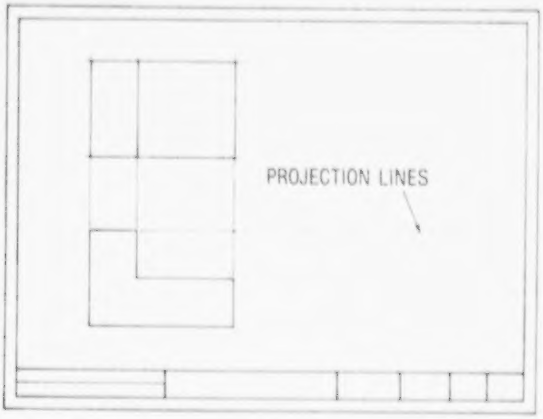
FIGURE 26


DEPTH
TOP VIEW

INFORMATION SHEET

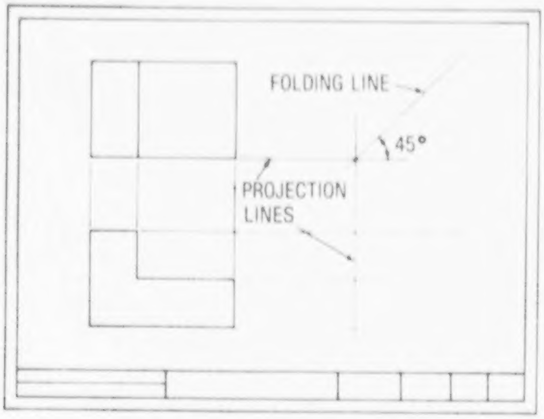
4. Draw horizontal projection lines from the height of the front view to the working area for the right side view.

FIGURE 27


PROJECTION LINES

5. Draw a horizontal projection line from the front edge of the top view to the right. Draw a vertical projection line at the location of the front edge of the side view. At the intersection of these projection lines, draw a 45° projection folding line.

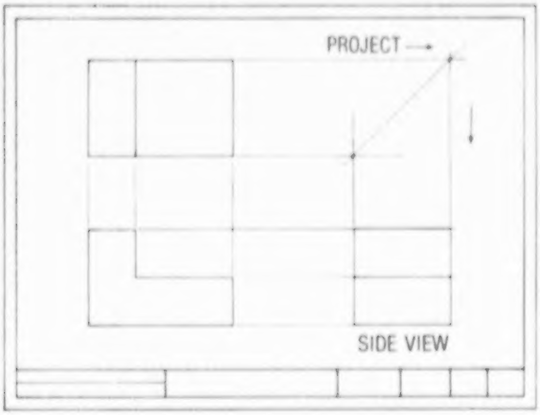
FIGURE 28


FOLDING LINE
45°
PROJECTION LINES

INFORMATION SHEET

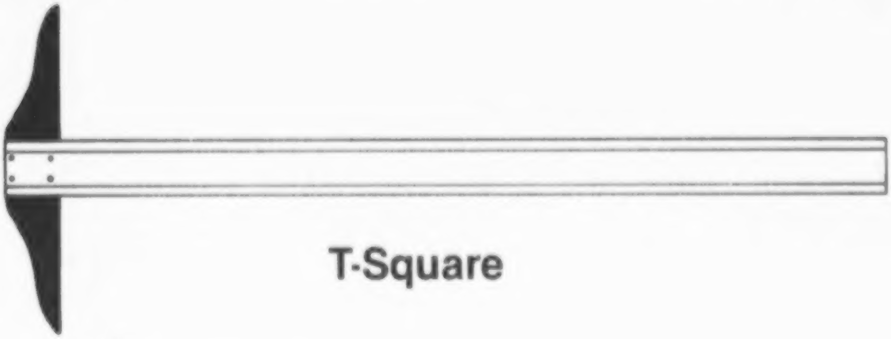
6. Draw horizontal projection lines from the depth of the top view to the folding line. Draw vertical projection lines from the folding line to show the depth in the side view, and lightly block in the side view.

FIGURE 29

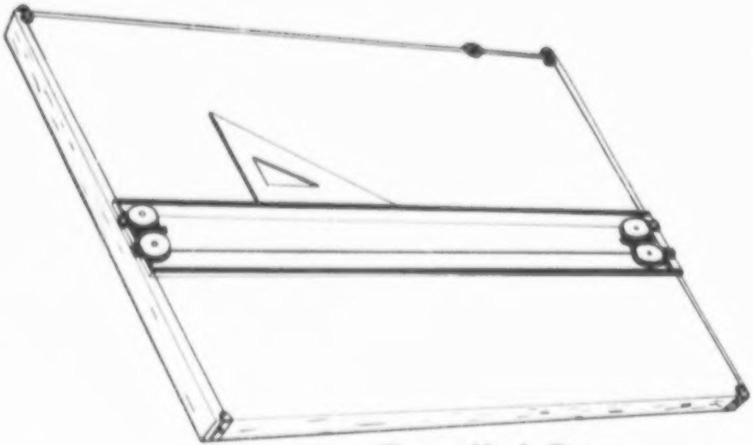


7. Check for errors and then darken the object lines.

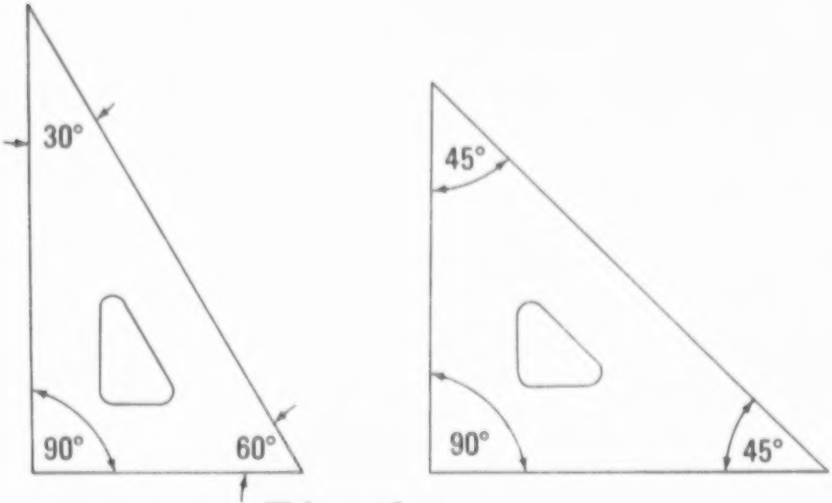
Manual Drafting Tools and Equipment



T-Square



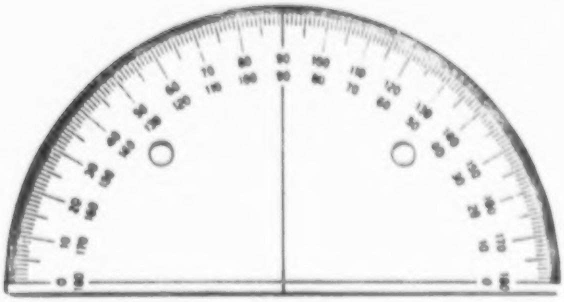
Parallel Bar


30°
90°
60°
45°
90°
45°

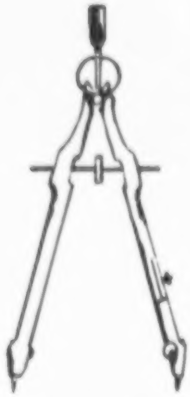
Triangles

Manual Drafting Tools and Equipment

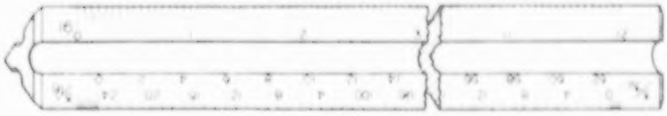
(Continued)



Protractor



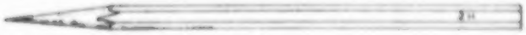
Compass



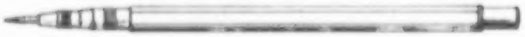
Scale
(Several types available)

101
Pink Pearl

Eraser



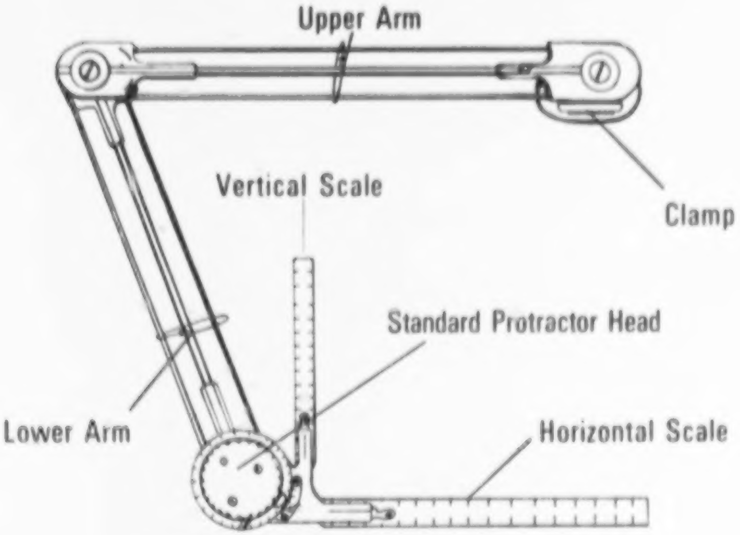
Wooden



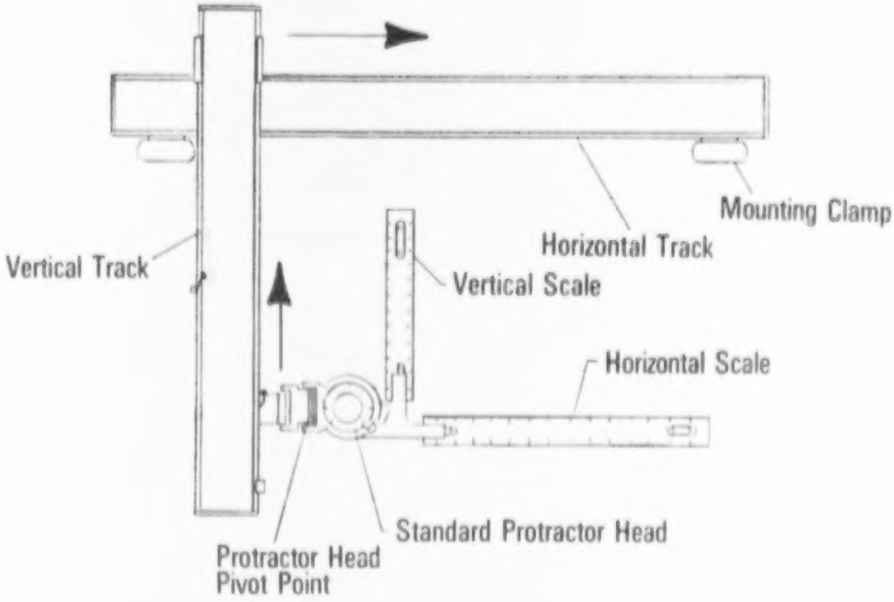
Mechanical

Pencils

Machine Drafting Equipment


Upper Arm
Vertical Scale
Clamp
Standard Protractor Head
Lower Arm
Horizontal Scale

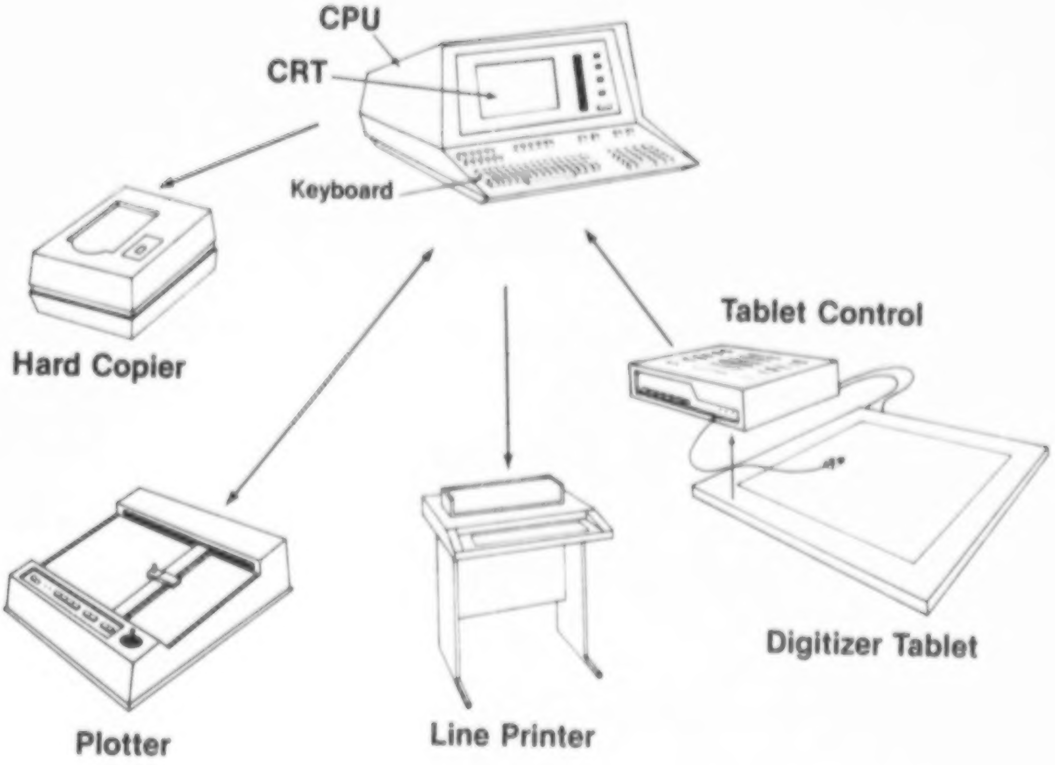
Arm Drafting Machine


Mounting Clamp
Horizontal Track
Vertical Track
Vertical Scale
Horizontal Scale
Standard Protractor Head
Protractor Head
Pivot Point

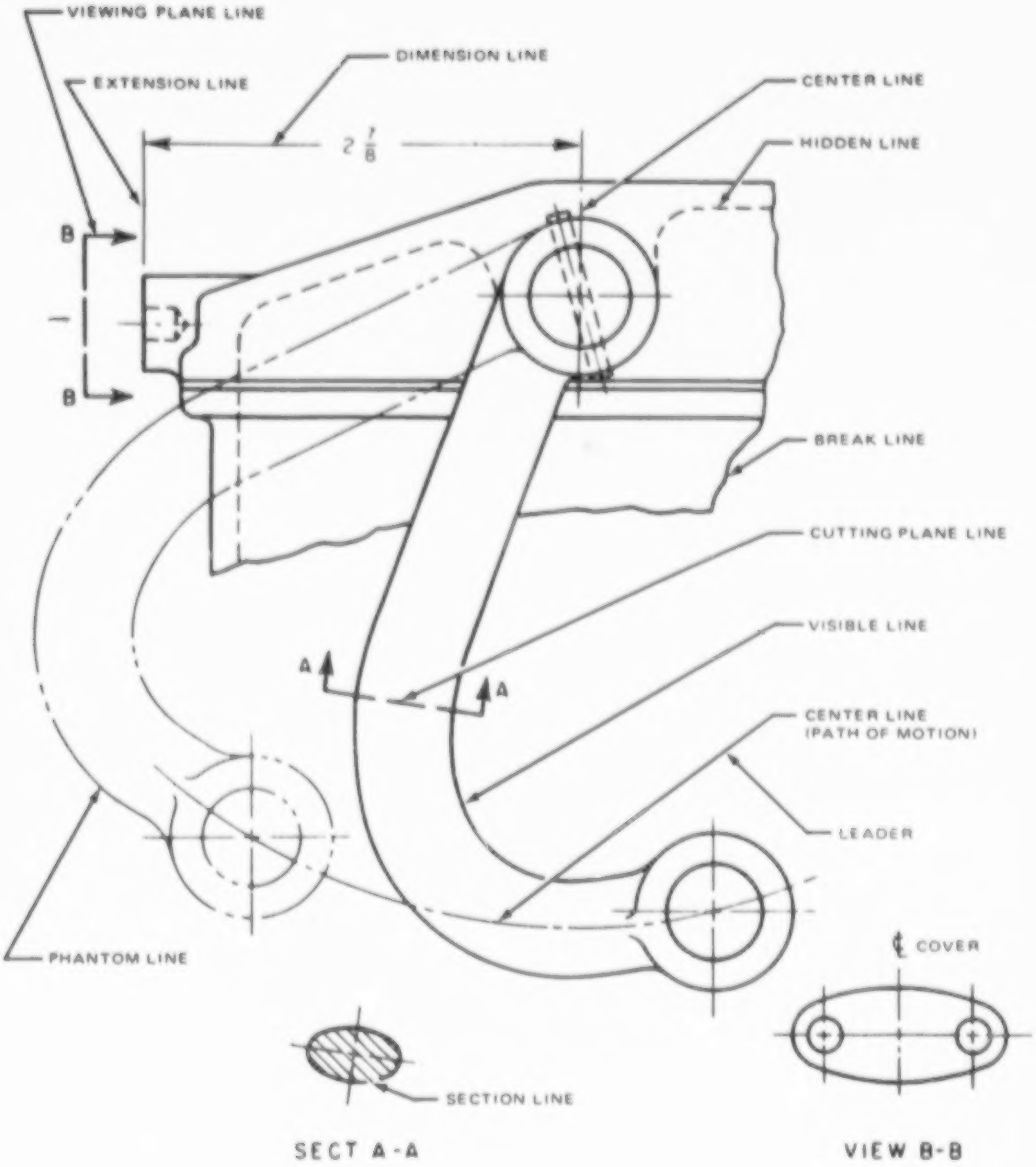
Track Drafting Machine

CAD Equipment

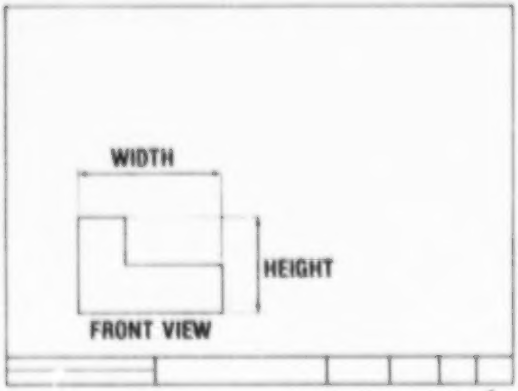
(Microcomputer)


CPU
CRT
Keyboard
Hard Copier
Tablet Control
Digitizer Tablet
Plotter
Line Printer

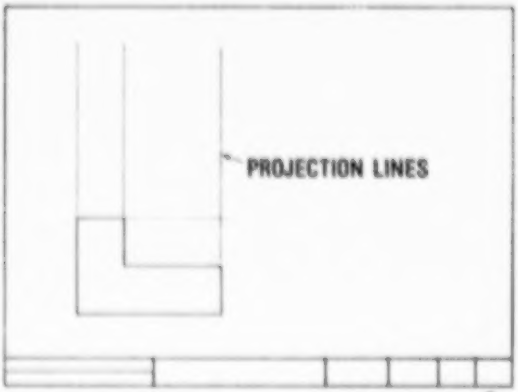
Use of the Alphabet of Lines


VIEWING PLANE LINE
DIMENSION LINE
EXTENSION LINE
CENTER LINE
2 7/8
HIDDEN LINE
B
B
BREAK LINE
CUTTING PLANE LINE
A
A
VISIBLE LINE
CENTER LINE (PATH OF MOTION)
LEADER
PHANTOM LINE
℄ COVER
SECTION LINE
SECT A-A
VIEW B-B

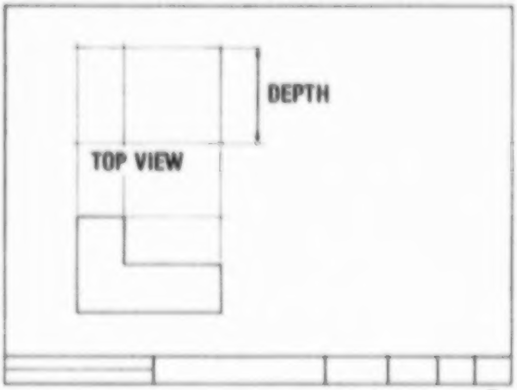
Steps in Orthographic Projection


WIDTH
HEIGHT
FRONT VIEW

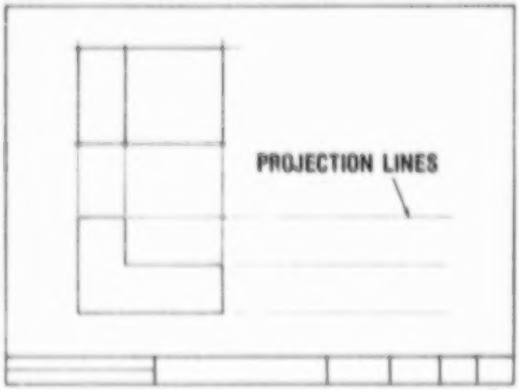
1.


PROJECTION LINES

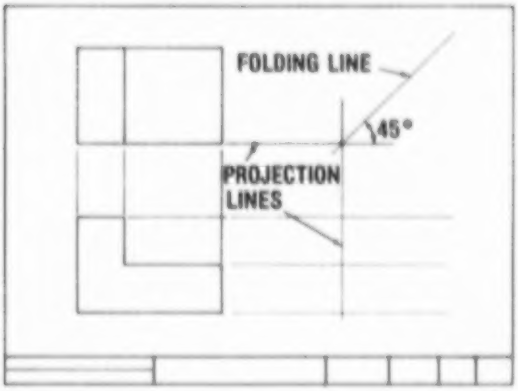
2.


DEPTH
TOP VIEW

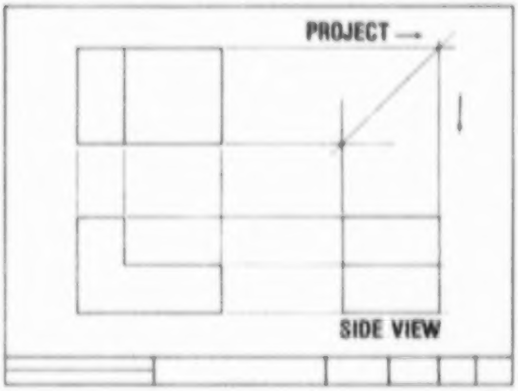
3.


PROJECTION LINES

4.


FOLDING LINE
45°
PROJECTION LINES

5.


PROJECT →
SIDE VIEW

6.

PRODUCING MESSAGES
UNIT III-B

ASSIGNMENT SHEET #1 — PREPARE AN ORAL PRESENTATION

NAME ______________________ SCORE ____________

Directions: This assignment will be used for preparing a 3-minute audio or audiovisual message such as the following:

- VCR presentation on topic of your choice
- Introduction of a classmate to your class or student organization
- Announcement or report on the school public address system
- Local radio announcement of class activity

Use the following steps for preparing your presentation:

1. Analyze subject.

   Examples: What do I need to say, who is my audience, how much can I cover in 3 minutes

2. Gather information.

   Examples: Interviewing, researching, surveying

3. Record key information. 3" × 5" index cards may be used.
4. Arrange material in logical order.
5. Develop visual aids as needed to enhance your presentation (if it is an audiovisual presentation.)

   (NOTE: Visual aids are an excellent way to create audience interest. The aids need to be large enough to be seen by the audience.)

6. Practice your delivery.
   a. Practice presentation in front of mirror.
   b. Give presentation in front of another person.
   c. Use tape or video recorder for evaluating presentation.
   d. Time your presentation. Remember it should be no longer than 3 minutes. This is especially important if it is a radio presentation.

PRODUCING MESSAGES
UNIT III-B

ASSIGNMENT SHEET #2 — MAKE AN ORAL PRESENTATION

NAME ______________________________ SCORE __________

Directions: Use your notes from Assignment Sheet #1 to make your presentation. Be sure not to exceed three minutes. The following points may help you in making your presentation:

Control Your Presentation

Set your pace to match the difficulty of the material. Plan your time. Don't rush yourself. Rushing makes you seem nervous.

Make Your Presentation Effective

Show enthusiasm. Use variety in your presentation. Make your speaking personal. Maintain eye contact and use natural gestures for audiovisual presentations.

Use Your Voice Wisely

Speak clearly and loudly enough so that all may hear. Speak slowly enough for meanings to be understood. It is better to cover less and cover it well. A little variation in your voice will avoid monotony. Talk to the audience, not to the window, the chalkboard, or the floor.

Now, just relax!

PRODUCING MESSAGES
UNIT III-B

ASSIGNMENT SHEET #3 — PREPARE A COMPREHENSIVE LAYOUT

NAME ______________________________________ SCORE ____________

(NOTE: This assignment should be developed in accordance with Assignment Sheet #3, "Design a Message," from Unit II-B.)

Directions: Using drafting tools and illustration board, develop a comprehensive layout. Use your rough from the previous assignment sheet as a guideline to position your layout. A mistake here is difficult to correct later. **Be accurate.**

(NOTE: This layout will be completed in the next assignment as a screen print, poster, or other graphic design.)

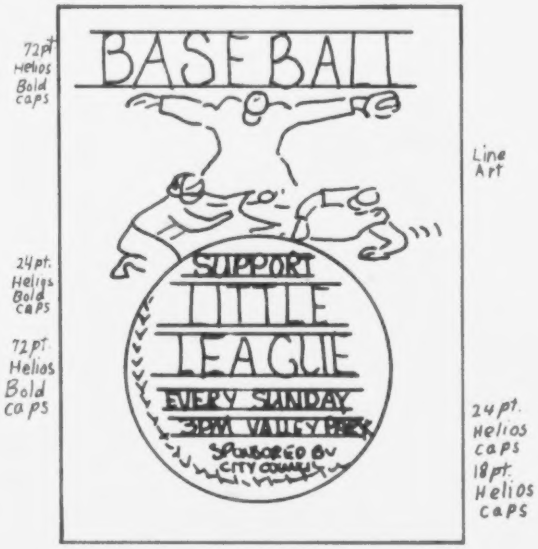
A. Mark guidelines lightly. Use your rough draft to help you position these lines.

B. Letter in all headlines. Use ink or preprinted transfer letters.

C. Show the location of text type. Draw two parallel lines for each line of text. Be certain you show the exact height and width of the final copy.

D. Match notes in layout's margins. Use notes to include size and style of type and other special instructions.

FIGURE 1

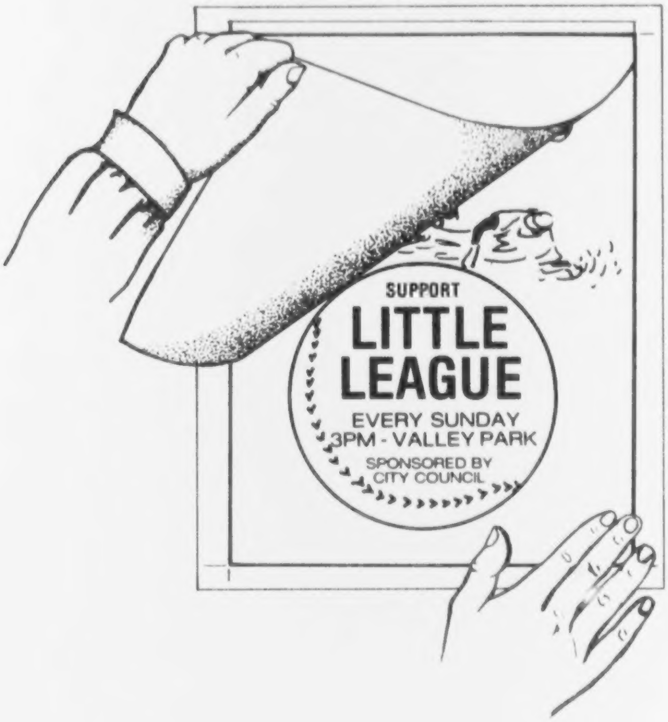

72pt Helios Bold caps
BASEBALL
Line Art
24pt. Helios Bold caps
SUPPORT
72pt. Helios Bold caps
LITTLE
LEAGUE
EVERY SUNDAY
3PM VALLEY PARK
SPONSORED BY
CITY COUNCIL
24pt. Helios caps
18pt. Helios caps

ASSIGNMENT SHEET #3

E. Attach artwork and photography. Sketch the image in the correct area if artwork is unavailable.

F. Cover the completed layout with a protective sheet of paper. Tape the cover sheet at the top so that the sheet may be flipped back to look at the comprehensive layout.

FIGURE 2


SUPPORT
LITTLE LEAGUE
EVERY SUNDAY
3PM - VALLEY PARK
SPONSORED BY CITY COUNCIL

PRODUCING MESSAGES
UNIT III-B

ASSIGNMENT SHEET #4 — COMPLETE A GRAPHIC DESIGN

NAME ____________________ SCORE ____________

Directions: Use the comprehensive layout from Assignment Sheet #3 to prepare your final product, and present it for evaluation.

PRODUCING MESSAGES
UNIT III-B

ASSIGNMENT SHEET #5 — PRACTICE READING UNITS OF MEASURE

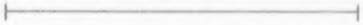
NAME ______________________________ SCORE __________

Directions: Practice using the scale correctly by measuring the distance between the markers on the lines below. Record your answers on the lines on the left.

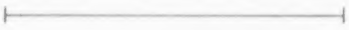
(NOTE: Reduce fractions as needed. For example, $^4/_{16}$" should be written $^1/_4$".)

	U.S. Customary (inch)	SI Metric (mm)
A.		
B.		
C.		
D.		
E.		
F.		
G.		
H.		
I.		
J.		

A



B



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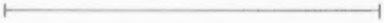

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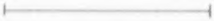

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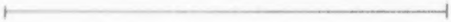

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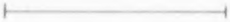

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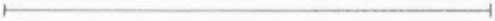

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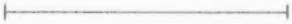

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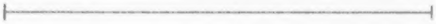

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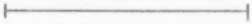


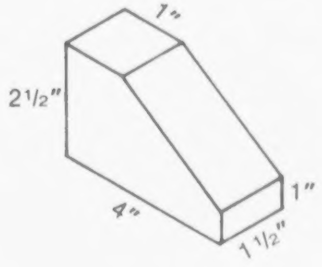
PRODUCING MESSAGES
UNIT III-B

ASSIGNMENT SHEET #6 — COMPLETE A THREE-VIEW ORTHOGRAPHIC DRAWING

NAME ______________________________ SCORE ____________

Part I

Directions: Make a three-view orthographic drawing of the object shown. Show the appropriate views and dimensions. Your instructor will provide the drawing media.



Part II

Directions: Use a CAD system to produce a drawing of the same object.

PRODUCING MESSAGES
UNIT III-B

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1-#4 — Evaluated to the satisfaction of the instructor

Assignment Sheet #5

A. 2" or 51 mm

B. $1^{15}/_{16}$" or 49 mm

C. $2^{1}/_{8}$" or 54 mm

D. $1^{3}/_{16}$" or 30 mm

E. $2^{1}/_{2}$" or 64 mm

F. $1^{1}/_{4}$" or 32 mm

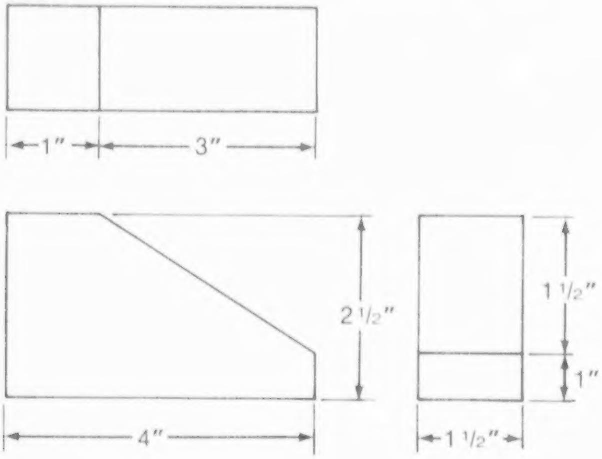
G. $2^{3}/_{4}$" or 70 mm

H. $1^{5}/_{8}$" or 41 mm

I. $2^{7}/_{16}$" or 62 mm

J. $1^{3}/_{8}$" or 35 mm

Assignment Sheets #6



PRODUCING MESSAGES
UNIT III-B

NAME ______________________________ SCORE ________________________

TEST

1. Match the terms on the right with the correct definitions.

_____a. A record-like object that records both audio and video information

_____b. An electronic device used to record and playback from a videotape the broadcast received by a television set

_____c. Using a computer to create or modify designs and drawings

_____d. Using a computer and appropriate software to layout, typeset, and print publications

_____e. Set of numbers that locate a point on a line, on a surface, or in space

1. CAD and CADD
2. Coordinates
3. Electronic desktop publishing
4. Electronic printing
5. Videocassette recorder
6. Videodisk
7. Magnetic tape
8. Record player

2. Complete the following statements concerning the methods of producing visual messages by circling the correct words.

a. (**Printing, Drafting**) is called the universal language of industry and modern technology.

b. (**Printing, Photography**) is the process of producing images on a sensitized surface (film) by the action of radiant energy. Exposed film is processed to produce a negative; then prints are made from the negatives using an enlarger in a darkroom.

c. (**CAD, Manual, Machine**) drafting uses traditional tools such as triangles, T-squares, and protractors.

d. (**Gravure, Offset**) printing is a printing process where the recessed image area is made by engraving, etching, or scratching.

e. (**Screen, Relief**) printing is a method of printing from a raised surface. The surface of the image is raised and inked. The image is transferred when the paper is pressed against the raised surface.

TEST

3. Match means of transmitting audio-audiovisual messages with the correct descriptions.

_____a.	An audio communication system that converts sound into electrical impulses for transmission primarily by wire.	1.	Computer
_____b.	An audio communication system that converts sound into electrical impulses for wireless transmission by means of electromagnetic waves	2.	Lasers
_____c.	A complex communication system using cameras, microphones, monitors, controls, and computers to record and transmit audio and video messages	3.	Radio
_____d.	An electronic device used to store, retrieve, and process information (data). Can be used to organize, manipulate, and transmit audio and video messages	4.	Telephone
		5.	Television

4. Complete the following statements concerning emerging communication transmission technologies by filling in the blanks with the correct words. The following words may be used but not all must be used: Radars, lasers, satellites, videocassettes, fiberoptics, microwaves, robotics.

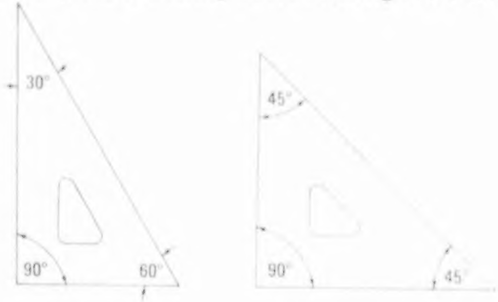
a. _____________ transmit signals (or messages) through the atmosphere using coherent electromagnetic radiation; do not use mechanical devices, fluids, or electrical wires.

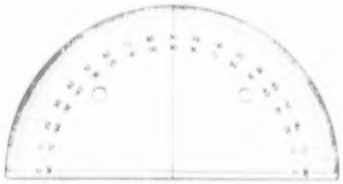
b. _____________ transmit light through thin transparent fibers of glass or plastic.

c. _____________ are wireless methods of sending signals over a long distance using short electromagnetic waves.

d. _____________ are man-made objects that orbit the earth that are used by telephone and television networks to receive and transmit audio and video messages over great distances. A dish is required to receive the signals.

5. Identify the following basic drafting tools and equipment.

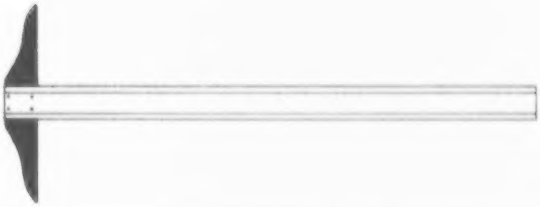




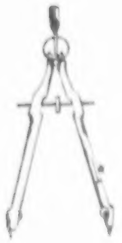
a. ________________________________

b. ________________________________

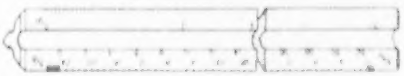
TEST



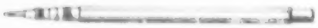
c. ____________________



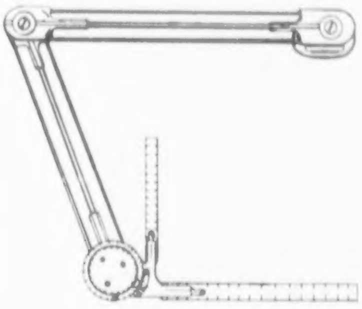
d. ____________________



e. ____________________

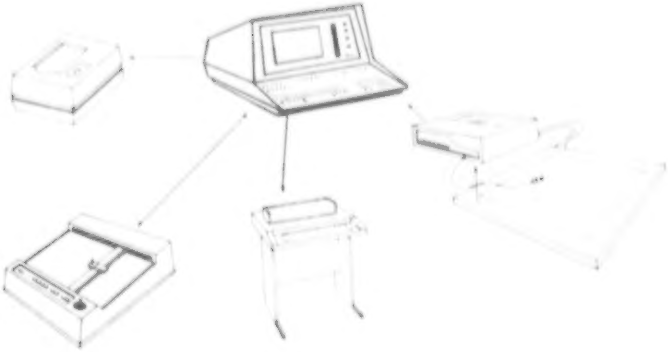


f. ____________________



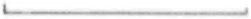
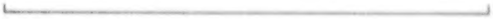
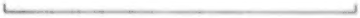
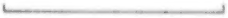
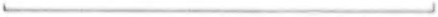
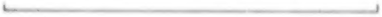
g. ____________________

TEST

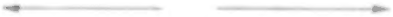


h. ______________________________

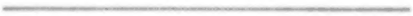
6. Measure the distance between the marks on the lines below and record both U.S. customary and SI metric readings.

	U.S. Customary	SI Metric
a. 	____________	____________
b. 	____________	____________
c. 	____________	____________
d. 	____________	____________
e. 	____________	____________
f. 	____________	____________

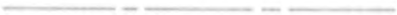
7. Identify the alphabet of lines shown below.



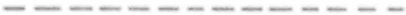
a. ______________________________



b. ______________________________



c. ______________________________



d. ______________________________

TEST

8. Select true statements concerning orthographic projection views by placing an "X" in the blanks preceding the true statements.

    _____a. The principal views in an orthographic projection show the width, height, and color of an object.

    _____b. The system used to establish and arrange the different views of a drawing is an orthographic projection.

    _____c. The principal views of an object are usually the front, top, and right side.

    _____d. If you project the views of an object onto the side of an imaginary glass box, you could visualize eight views.

9. Arrange in order the steps in developing an orthographic drawing by placing the correct sequence numbers (1-5) in the appropriate blanks.

    _____a. Select views to be illustrated.

    _____b. Draw the views.

    _____c. Space the views in the drawing space.

    _____d. Align and secure paper carefully to drawing surface.

    _____e. Prepare border as directed by instructor.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

10. Prepare an oral presentation. (Assignment Sheet #1)

11. Make an oral presentation. (Assignment Sheet #2)

12. Prepare a comprehensive layout. (Assignment Sheet #3)

13. Complete a graphic design. (Assignment Sheet #4)

14. Practice reading units of measure. (Assignment Sheet #5)

15. Complete a three-view orthographic drawing. (Assignment Sheet #6)

PRODUCING MESSAGES
UNIT III-B

ANSWERS TO TEST

1. a. 6
   b. 5
   c. 1
   d. 3
   e. 2

2. a. Drafting
   b. Photography
   c. Manual
   d. Gravure
   e. Relief

3. a. 4
   b. 3
   c. 5
   d. 1

4. a. Lasers
   b. Fiberoptics
   c. Microwaves
   d. Satellites

5. a. Triangles
   b. Protractor
   c. T-square
   d. Compass
   e. Scale
   f. Pencil — mechanical
   g. Drafting machine — arm-type
   h. CAD system

6. a. $1\frac{3}{8}$" or 35 mm
   b. $2\frac{3}{4}$" or 70 mm
   c. 2" or 51 mm
   d. $1\frac{1}{4}$" or 32 mm
   e. $2\frac{7}{16}$" or 62 mm
   f. $2\frac{1}{8}$" or 54 mm

7. a. Dimension line
   b. Visible object line
   c. Center line
   d. Hidden object line

ANSWERS TO TEST

8. a. False
   b. True
   c. True
   d. False

9. a. 3
   b. 5
   c. 4
   d. 1
   e. 2

10.-15. Evaluated to the satisfaction of the instructor

EVALUATING MESSAGES
UNIT IV-B

UNIT OBJECTIVE

After completion of this unit, the student should be able to evaluate messages and their communication organization. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Discuss areas for evaluating a presenter.
2. Name points to consider when evaluating an orthographic drawing.
3. Distinguish between two areas when evaluating an organized communication system.
4. Arrange in order steps used to close an organization.
5. Evaluate the communication system. (Assignment Sheet #1)
6. Close the organization. (Assignment Sheet #2)

EVALUATING MESSAGES
UNIT IV-B

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Use this unit to wrap up activities in all areas.

2. Use Assignment Sheet #1 to allow all students the opportunity to stand before a group and make a short presentation. Make a VCR tape of the assignment if possible. Use the tape for evaluation.

3. Use the evaluation and wrap-up to find the special interest areas the students have developed. Plan to build on this interest in future activities.

4. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Administer test.

I. Evaluate test.

J. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Hauenstein, A. Dean and Steven A. Bachmeyer. *The World of Communications: Audiovisual Media.* Bloomington, IL: McKnight Publishing Co., 1975.

B. Jones, Ronald E. and Janet L. Robb. *Discovering Technology Communication.* Dallas, TX: Harcourt Brace Jovanovich Publishers, 1986.

EVALUATING MESSAGES
UNIT IV-B

INFORMATION SHEET

I. **Areas for evaluating a presenter** (Transparencies 1 and 2)

   A. Knowledge of subject

      1. Used relevant information.

      2. Used logical order for presentation.

      3. Presented information well.

      4. Related to the audience well.

   B. Delivery

      1. Used good eye contact.

      2. Used hand gestures correctly.

      3. Controlled voice well.

      4. Spoke clearly and in a pleasant tone.

   C. Overall impression

      1. Was neatly groomed.

      2. Was enthusiastic and confident.

      3. Had good posture.

II. **Evaluate an orthographic drawing**

   A. Views give good illustration.

   B. Spacing between views is correct.

   C. Border is correct and complete.

   D. Dimensions are correct.

   E. Line quality is good.

   F. Lettering is neat and uniform.

INFORMATION SHEET

III. **Evaluating an organized communication system** (Transparency 3)

(NOTE: The success of a product or service can be measured by evaluating the system. Consider the following when evaluating your organization or project.)

A. Product or service evaluation

1. Customer or receiver response
2. Product reception
3. Consumer feedback

B. Profit and loss evaluation

1. Sales
2. Cost of goods sold
3. Gross profit on sales
4. Operating income
5. Taxes or fees
6. Net income

IV. **Steps in closing an organization**

(NOTE: The process in closing all company operations or activities is called dissolution. The company or organization that was organized is dissolved. The people that were hired leave. Equipment, materials, and finished goods are sold.)

A. Stop all sales or service activities.

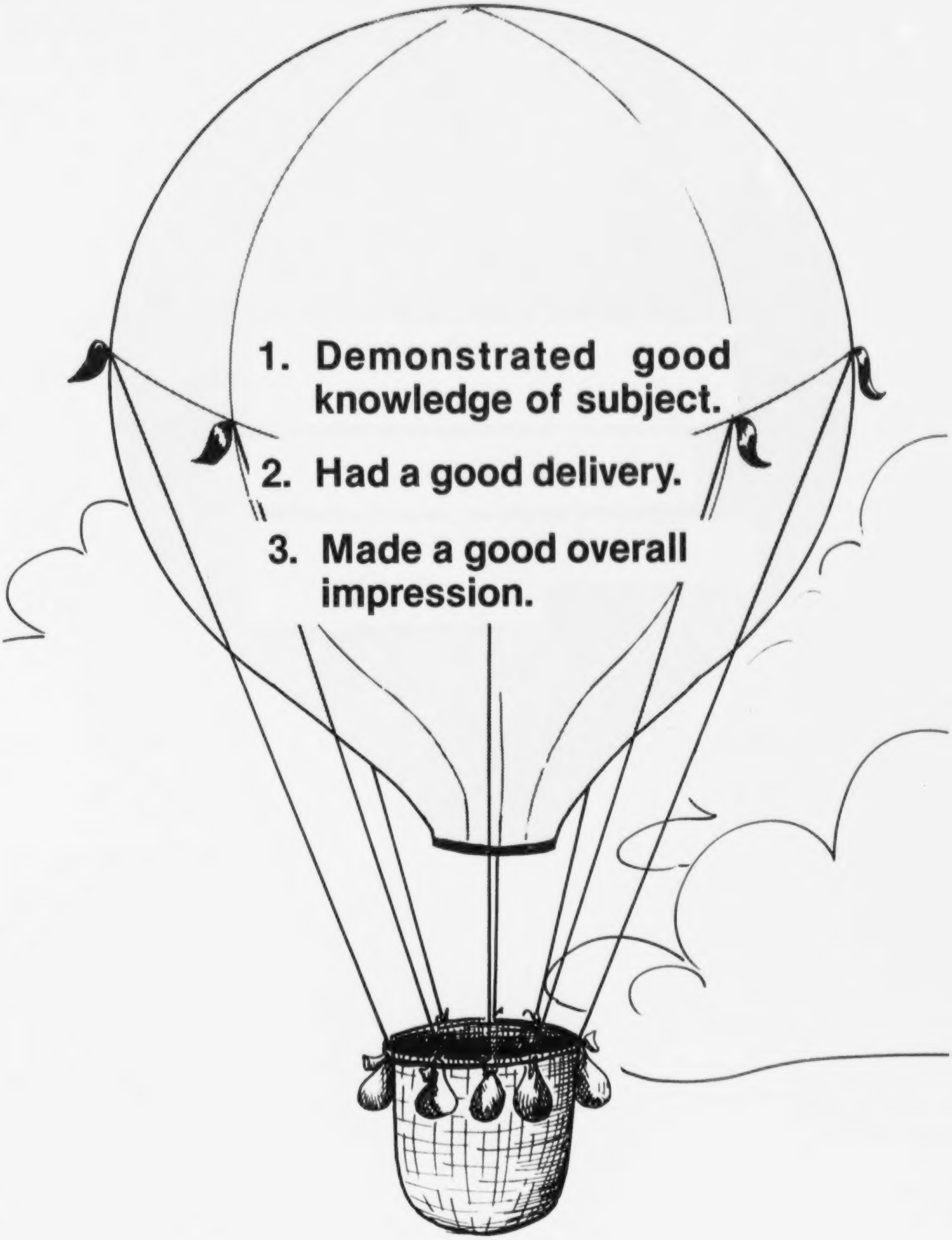
B. Cease delivery of all products.

C. Dismiss all employees.

D. Sell all assets.

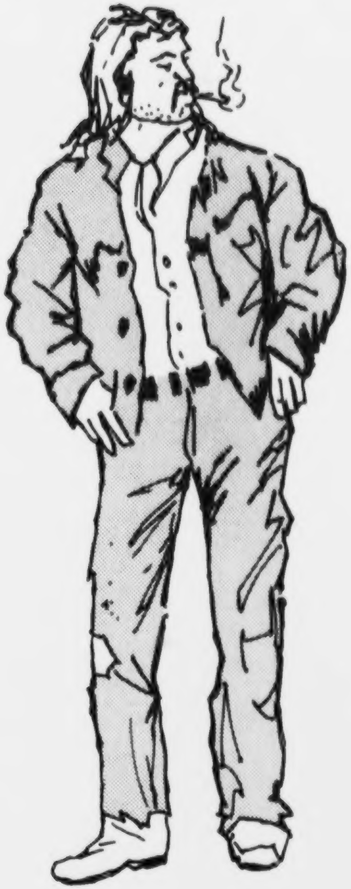
E. Return laboratory or facility to original state.

Presentation Highpoints



1. Demonstrated good knowledge of subject.
2. Had a good delivery.
3. Made a good overall impression.

Make a Good Impression



Have Hair Neatly Trimmed and Combed

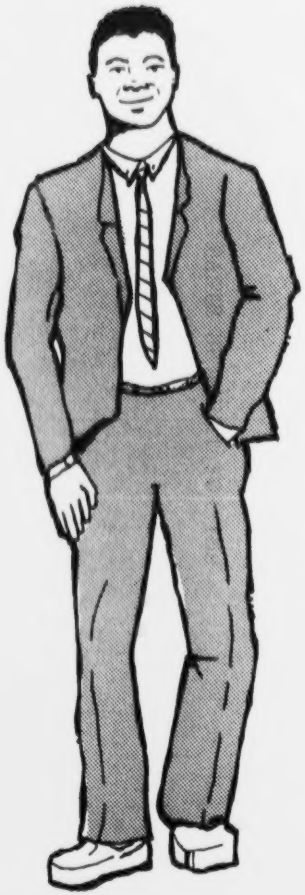
Be Well Groomed

Dress Appropriately

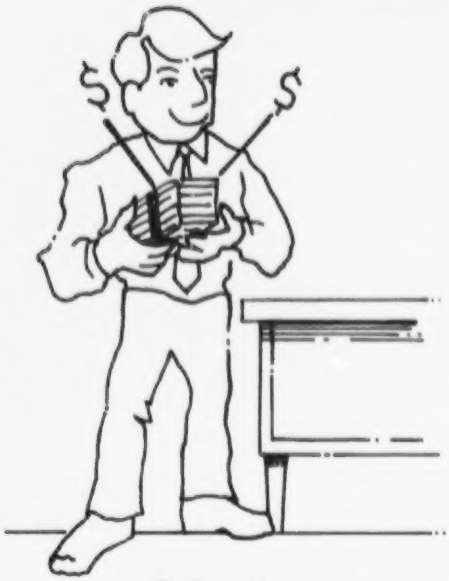
Keep Shoes in Good Repair

Use Good Posture

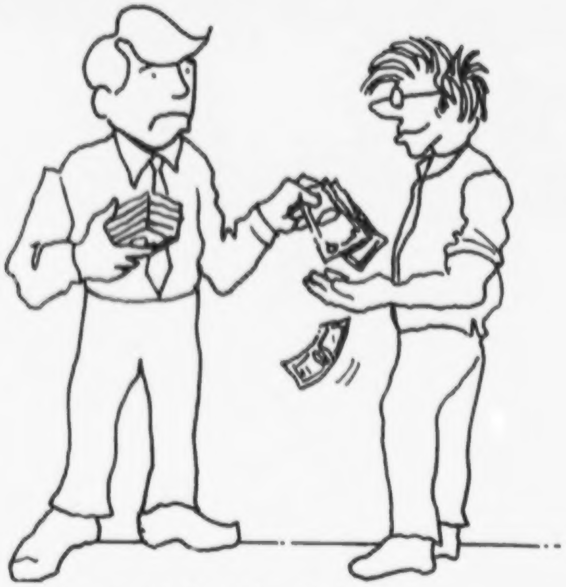
Look Enthusiastic and Confident



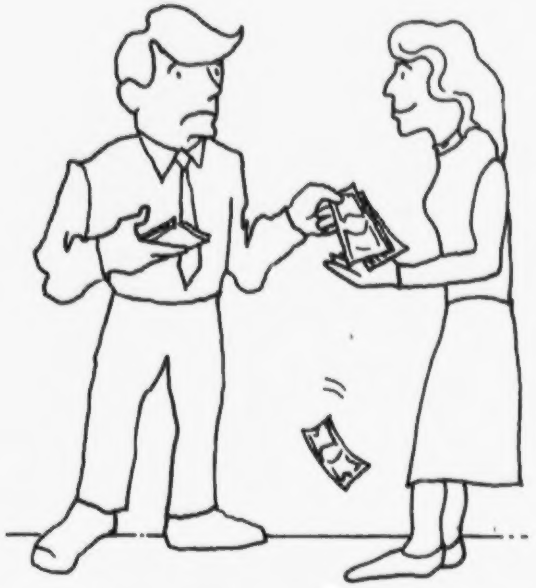
Evaluating the System



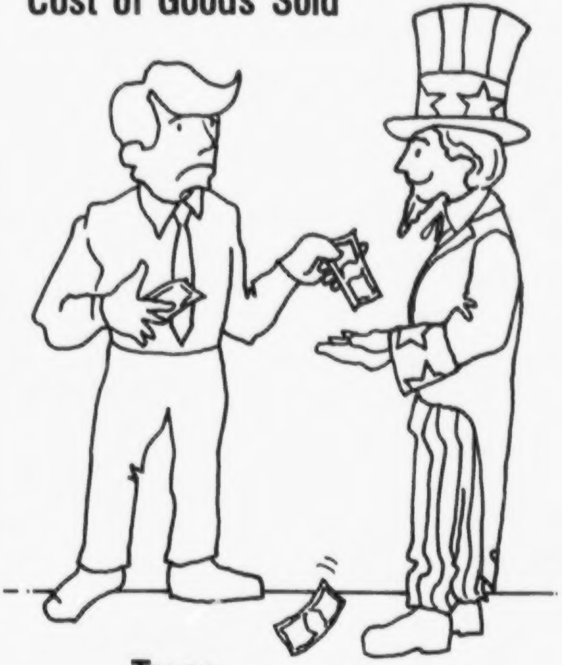
Sales Income



Cost of Goods Sold



Operating Costs



Taxes

Approximately 95 percent of the income from sales goes to pay expenses.

EVALUATING MESSAGES
UNIT IV-B

ASSIGNMENT SHEET #1 — EVALUATE THE COMMUNICATION SYSTEM

NAME ______________________________ SCORE ____________

Directions: Follow the instructor's directions and discuss or list the advantages or disadvantages of the product or service you have used as your communication project in this unit.

Things to consider:

1. Was the project well chosen?____________________
2. Was the information gathered during research correct?____________________
3. Would changes be made if you were starting again?____________________
4. Was it cost effective?____________________

Rate your project by completing the following chart:

Excellent	Good	Poor	
			Customer or receiver response to product or service
			Sales
			Cost of goods sold
			Gross profit on sales
			Operating income
			Taxes or fees
			Net income
			Overall project evaluation

EVALUATING MESSAGES
UNIT IV-B

ASSIGNMENT SHEET #2 — CLOSE THE ORGANIZATION

NAME ________________________________ SCORE __________

Directions: Follow instructor's directions and participate as a class member while closing the organization. The following steps should be included:

1. Stop all sales or service activities.
2. Cease delivery of all products.
3. Dismiss all employees.
4. Sell all assets.
5. Return laboratory or facility to original state.

EVALUATING MESSAGES
UNIT IV-B

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1 — This may be a class discussion used to wrap-up the unit. Have the students record some of their ideas.

Assignment Sheet #2 — Evaluated to the satisfaction of the instructor

EVALUATING MESSAGES
UNIT IV-B

NAME ______________________ SCORE ____________________

TEST

1. Discuss the following areas for evaluating a presenter.

   a. How do you know if a presenter has a good knowledge of the subject? ______

   ____

   ____

   b. What would you look for in evaluating a presenter's delivery? ______

   ____

   c. What types of things help a presenter make a good overall impression? ______

   ____

   ____

2. Name four points to consider when evaluating an orthographic drawing.

   a. ____

   b. ____

   c. ____

   d. ____

3. Distinguish between the two areas when evaluating an organized communication system by placing an "X" next to the items considered product or service evaluation areas and an "O" next to those for profit and loss evaluation.

   _____a. Operating income

   _____b. Net income

   _____c. Taxes and fees

   _____d. Product reception

   _____e. Customer or receiver reception

TEST

______f. Gross profit on sales

______g. Sales

______h. Cost of goods sold

______i. Consumer feedback

4. Arrange in order the following steps in closing an organization by placing the correct sequence numbers (1-5) in the appropriate blanks.

______a. Sell all assets.

______b. Dismiss all employees.

______c. Stop all sales or service activities.

______d. Return laboratory or facility to original state.

______e. Cease delivery of all products.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

5. Evaluate the communication system. (Assignment Sheet #1)

6. Close the organization. (Assignment sheet #2)

EVALUATING MESSAGES
UNIT IV-B

ANSWERS TO TEST

1. Discussion should include:
   a. Knowledge of subject
      1) Used relevant information.
      2) Used logical order for presentation.
      3) Presented information well.
      4) Related to the audience well.
   b. Delivery
      1) Used good eye contact.
      2) Spoke clearly and in a pleasant tone.
      3) Used hand gestures correctly.
      4) Controlled voice well.
   c. Overall impression
      1) Was neatly groomed.
      2) Was enthusiastic and confident.
      3) Had good posture.

2. Any four of the following:
   a. Views give good illustration.
   b. Spacing between views is correct.
   c. Border is correct and complete.
   d. Dimensions are correct.
   e. Line quality is good.
   f. Lettering is neat and uniform.

3. a. O
   b. O
   c. O
   d. X
   e. X
   f. O
   g. O
   h. O
   i. X

4. a. 4
   b. 3
   c. 1
   d. 5
   e. 2

5.-6. Evaluated to the satisfaction of the instructor.

INTRODUCTION TO CONSTRUCTION
UNIT I-C

UNIT OBJECTIVE

After completion of this unit, the student should be able to define construction technology, discuss how it relates to the past, present, and future, and research careers related to this field. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Complete statements concerning the development of structures.
2. Define construction technology.
3. Complete statements concerning how construction technology affects society.
4. Complete statements concerning the types of construction.
5. Distinguish between construction technology careers.
6. Identify the major types of construction in your community. (Assignment Sheet #1)
7. Research a construction technology career. (Assignment Sheet #2)
8. Complete a word search of construction careers. (Assignment Sheet #3)
9. Sketch a floor plan of a house. (Assignment Sheet #4)
10. List construction careers involved in building a house. (Assignment Sheet #5)
11. Design a cardboard model house. (Assignment Sheet #6)

INTRODUCTION TO CONSTRUCTION
UNIT I-C

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Provide students with objective sheet.

C. Discuss unit and specific objectives.

D. Provide students with information and assignment sheets.

E. Discuss information and assignment sheets.

F. Integrate the following activities throughout the teaching of this unit:

   1. Introduce unit by discussing planned activities and projects to create interest.

   2. Distribute Handout #1, "Parent Communiqué" with instructions for return date.

   3. Reinforce types of construction by having students bring pictures or news articles of construction projects. Make a display board.

   4. Encourage career research by inviting different construction employers/employees from the community to speak to the class.

   5. Plan to use *School Shop* and other construction related publications as a resource while teaching these units.

   6. Use AIASA Competitive Events Guidelines format for research papers.

   7. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

G. Administer test.

H. Evaluate test.

I. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Henak, Richard M. *Exploring Construction.* South Holland, IL: Goodheart-Willcox Company, Inc., 1985.

B. Feirer, John L. and John R. Lindbeck. *Production Technology.* Peoria, IL: Bennett & McKnight Publishing Company, 1986.

C. Williams, Charles F., Kamlian S. Badikham, and Willard R. Daggett. *Technology For Tomorrow.* Cincinnati, OH: South-Western Publishing Company, 1985.

D. Bame, E. Allen and Paul Cummings. *Exploring Technology.* Worcester, MA: Davis Publications, 1980.

SUGGESTED SUPPLEMENTAL MATERIALS

A. Construction Software (Apple, IBM, TRS-80, others)

1. "Tools"
2. "Framing Processes"
3. "Blueprint Reading"
4. "Estimating"
5. "Introduction to Solar Energy"

Available from: National Innovative Media Co.
Route #2, Box 301B
Calhoun, KY 42327
1-800-962-6662

B. *Construction: Basic Principles*
RMI Media Productions, Inc.
120 West 72nd Street
Kansas City, MO 64114

C. Filmstrips

1. *The Foundation*
2. *Wood Shell*

The University of Wisconsin
Bureau of Audio-Visual Instruction
P.O. Box 2093
Madison, WI 53701-2093

INTRODUCTION TO CONSTRUCTION
UNIT I-C

INFORMATION SHEET

I. **The development of structures** (Transparency 1)

   A. Caves — Before history was recorded, people lived in caves. These were shelters formed by nature. People had to search for a cave that was the correct size and shape for their needs.

   B. Movable homes — These shelters developed as it became necessary to travel and search for food. Tents made from poles cut from trees and animal skins provided a shelter that could be taken apart quickly and carried from place to place.

   C. Permanent homes — Once people learned to farm and produce their own food, the need to move around in search of food was no longer necessary. The first permanent structures of sticks and mud were built. Eventually other materials were used. Later tools were developed to assist in construction.

   D. Urbanization — As people came together to live in towns and cities, their needs for structures changed. It became necessary to utilize space and provide safe structures for families. New construction technologies developed. Multiple floor dwellings developed. Foundations were needed to support layers of rooms.

   (NOTE: New types of structures were needed to accommodate the need for open space. Factories, churches, and cathedrals had to be designed to accommodate large groups of people.)

II. **Definition of construction technology** — The effective use of materials, labor, equipment, methods, and management resources to produce a structure on site

III. **Construction technology affects society**

   A. Construction makes our life more pleasant.

      1. Provides comfortable homes.

      2. Protects us from the elements.

      3. Provides easier transportation.

   B. Construction creates environmental problems.

      1. Modern highways require space.

      2. Construction projects often leave ugly scars.

      3. Air, water, and land are often polluted.

      4. Natural resources are depleted.

INFORMATION SHEET

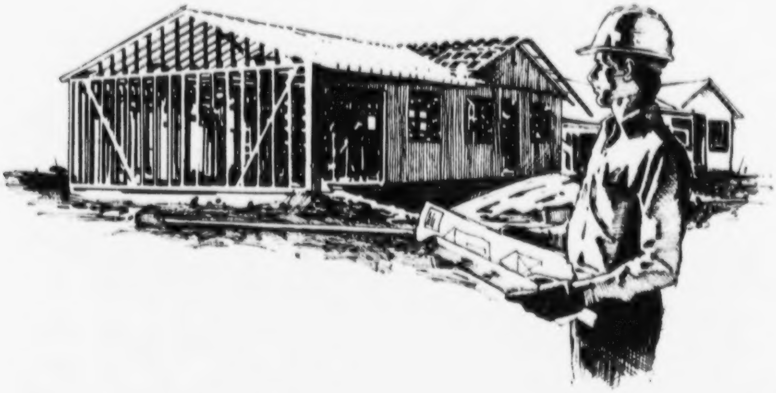
C. Construction must plan for the future.

1. Use space wisely.
2. Protect and replenish natural resources.
3. Design alternate energy sources into buildings.

IV. **Major types of construction**

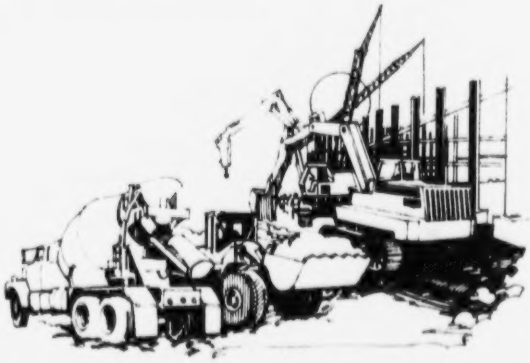
A. Residential or light construction — Concerned mainly with the building of homes, apartments, condominiums, and small commercial buildings

(NOTE: These are primarily of wood frame construction.)



B. Commercial construction — Primarily involved with the erection of commercial, industrial, educational, and institutional buildings

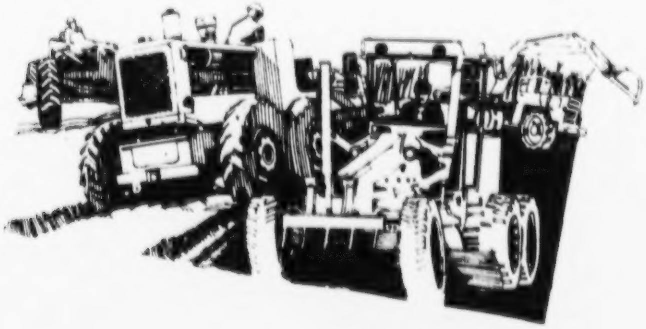
(NOTE: Materials include steel, concrete, brick, glass, and ceramics. Interiors may be of wood construction.)



INFORMATION SHEET

C. Civil and/or heavy construction — Includes the building of highways, railroads, pipelines, public utilities, water and sewer systems, dams, bridges, and electrical utilities

(NOTE: Many different materials are used such as gravel, earth, sand, steel, oil, wood, cement, glass, and plastic.)



V. **Construction technology careers**

(NOTE: The construction industry offers many career opportunities. These careers require different degrees of education. Some jobs are available for people who do not finish high school. Other jobs require three to five years of apprenticeship [on-the-job training], vocational and technical training [vocational school or community college], or college degrees.)

A. Professional careers — Training usually requires a person being licensed in the state in which work is being done. A degree from an accredited college or university is required and then a number of years are spent in an internship.

1. Architects — Design houses, commercial buildings, schools, etc.
2. Civil engineers — Design and supervisor construction of roads, airfields, tunnels, dams, etc.
3. Electrical engineers — Design, manufacture, and install power plants and communication systems
4. Contractors — Manage and supervise construction.

(NOTE: A degree is not required but a license is often required.)

INFORMATION SHEET

B. Technical careers — Training requires 2-4 years of specialization. Includes careers in designing, planning, expediting, and distributing.

   1. Drafters — Assist professionals in developing complete sets of detailed drawings with exact dimensions and specifications of the structure and all its parts.

   2. Surveyors — Indicate accurate placement of the building on the land and property boundaries

   3. Expeditors — Ensure that materials arrive on time and in correct order at the construction site

   4. Inspectors — Test and inspect the materials used on a project

C. Skilled construction careers (trade occupations) — Training could include 3-5 years of apprenticeship (on-the-job training) or vocational and technical training at a vocational school or community college.

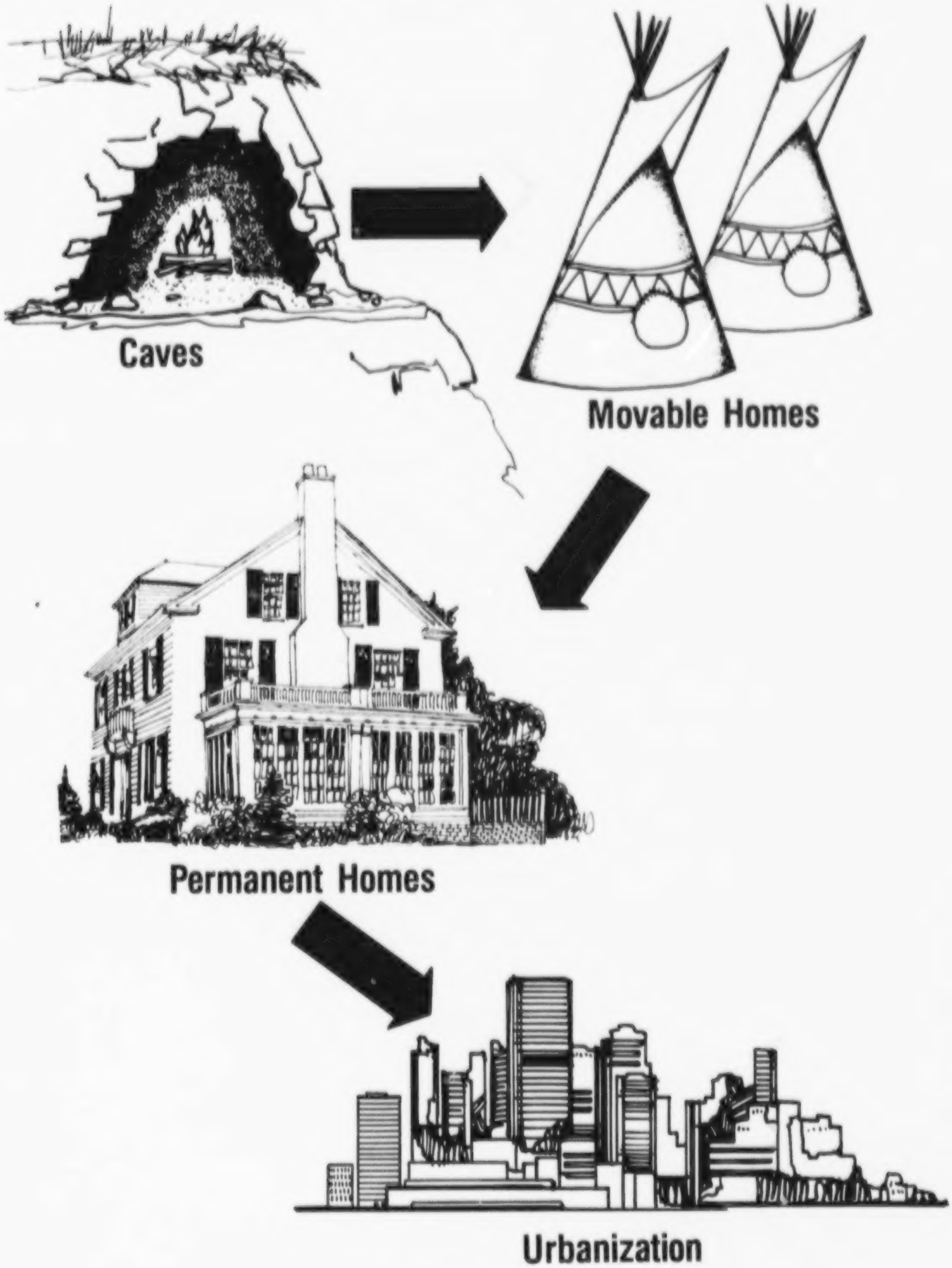
(NOTE: This area has three divisions.)

   1. Structural workers: Carpenters, bricklayers, masons, iron workers, welders, etc.

   2. Finishing workers: Plasterers, drywall installers, marble and terrazzo workers, painters, glaziers, roofers, floor layers, and insulation workers

   3. Mechanical workers: Plumbers, pipefitters, operating engineers, and elevator constructors

Development of Structures


Caves
Movable Homes
Permanent Homes
Urbanization

INTRODUCTION TO CONSTRUCTION
UNIT I-C

HANDOUT #1 — PARENT COMMUNIQUÉ

Dear Parent or Guardian:

The purpose of this communique is to inform you that ______________________ will be participating in Construction Technology. A number of exciting and challenging activities are planned. Among these activities will be

____

____

____

During these weeks of study, technology education students will be using equipment, tools, and chemicals related to this area of study. Safe practices are encouraged in the laboratory and classroom at all times. Please sign and return this letter to me to indicate that you have no objection to your student's participation in these laboratory activities. The student will also sign this letter to indicate a willingness to practice safe work habits.

You are invited to visit our program at any time. Please feel free to call the office to set a time.

Thank you,

____
(Instructor)

I will practice safe work habits in the laboratory at all times.

______________________________ ______________
(Student's Signature) (Date)

______________________________ ______________
(Parent or Guardian Signature) (Date)

INTRODUCTION TO CONSTRUCTION
UNIT I-C

ASSIGNMENT SHEET #1 — IDENTIFY THE MAJOR TYPES OF CONSTRUCTION IN YOUR COMMUNITY

NAME ______________________________ SCORE __________

Directions: For the area where you live, list an example of the three types of construction. List the types of materials used in each.

A. ______________________________

Materials used ______________________________

____

B. ______________________________

Materials used ______________________________

____

C. ______________________________

Materials used ______________________________

____

INTRODUCTION TO CONSTRUCTION
UNIT I-C

ASSIGNMENT SHEET #2 — RESEARCH A CONSTRUCTION TECHNOLOGY CAREER

NAME ____ SCORE ____________

Directions: Examples of careers in the construction field were discussed in Information Sheet, Section V. You may also be able to name other careers. Select a career you think you would be good in. Research for more details.

Examples:
1. What is the exact training needed?
2. Where can you get that training?
3. What are the working conditions for that job?
4. What are the future possibilities of employment?
5. Why would you be good at that job?

Compile the results of your research and present it either in written or oral form as requested by your instructor.

A written research paper should include the following:

- Title page
- Table of contents
- Introduction
- Review of literature (body)
- Conclusion
- End notes/Footnotes (if applicable)

INTRODUCTION TO CONSTRUCTION
UNIT I-C

ASSIGNMENT SHEET #3 — COMPLETE A WORD SEARCH OF CONSTRUCTION CAREERS

NAME ______________________________ SCORE __________

Directions: Find the construction careers in the word search below and circle the correct letters. The words may be horizontal, vertical, diagonal, or BACKWARDS.

1. Architect
2. Bricklayer
3. Carpenter
4. Contractor
5. Drafter
6. Drywall installer
7. Engineer
8. Floor layer
9. Glazier
10. Inspector
11. Insulation worker
12. Iron worker
13. Mason
14. Painter
15. Pipefitter
16. Plasterer
17. Plumber
18. Roofer
19. Surveyor
20. Welder

A	D	X	Y	C	E	F	L	O	T	S	D	A	E	I	R	R	Y
A	R	C	H	I	T	E	C	T	B	A	C	I	T	N	U	L	L
I	Y	P	E	C	A	R	P	E	N	T	E	R	Q	S	O	P	R
Z	W	X	I	R	S	S	E	P	A	L	R	L	A	U	A	W	X
X	A	B	B	P	L	A	S	T	E	R	E	R	K	L	L	K	O
B	L	A	T	R	E	D	L	E	W	I	T	Q	X	A	Y	T	W
O	L	I	P	C	D	F	C	O	N	T	R	A	C	T	O	R	E
F	I	H	J	G	P	A	I	N	T	E	R	H	G	I	K	M	M
N	N	K	P	Q	F	B	F	T	E	S	L	R	J	O	Q	L	P
T	S	U	R	V	E	Y	O	R	T	O	E	I	Y	N	X	J	J
F	T	A	A	S	P	I	T	J	F	E	O	O	R	W	A	T	E
M	A	S	O	N	L	I	I	G	N	E	R	O	J	O	K	S	P
O	L	G	J	K	U	E	P	I	R	O	N	W	O	R	K	E	R
A	L	L	B	C	M	E	G	G	I	D	J	K	L	K	M	I	U
B	E	A	U	X	B	N	X	L	S	R	O	O	F	E	R	X	S
T	R	Z	B	H	E	I	S	M	I	F	A	O	L	R	O	H	E
A	M	I	J	E	R	E	T	F	A	R	D	K	L	E	X	M	O
H	U	E	C	L	A	H	M	M	E	I	N	J	B	I	E	T	E
C	C	R	U	K	K	I	N	S	P	E	C	T	O	R	R	S	I
F	L	O	O	R	L	A	Y	E	R	Y	L	J	U	L	K	J	S

INTRODUCTION TO CONSTRUCTION
UNIT I-C

ASSIGNMENT SHEET #4 — SKETCH A FLOOR PLAN OF A HOUSE

NAME ______________________________ SCORE __________

Directions: Use grid paper provided by your instructor to sketch the floor plan of your house. Make a list of the good features of your house and a list of things that could be changed to improve your house.

Good features

____

____

____

____

____

____

____

Possible improvements

____

____

____

____

____

____

____

____

INTRODUCTION TO CONSTRUCTION
UNIT I-C

ASSIGNMENT SHEET #5 — LIST CONSTRUCTION CAREERS INVOLVED IN BUILDING A HOUSE

NAME ______________________________ SCORE __________

Directions: Make a list of the different people (by career title) that helped to build your house.

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________
7. ______________________________
8. ______________________________
9. ______________________________
10. ______________________________

INTRODUCTION TO CONSTRUCTION
UNIT I-C

ASSIGNMENT SHEET #6 — DESIGN A CARDBOARD MODEL HOUSE

NAME ______________________________ SCORE ____________

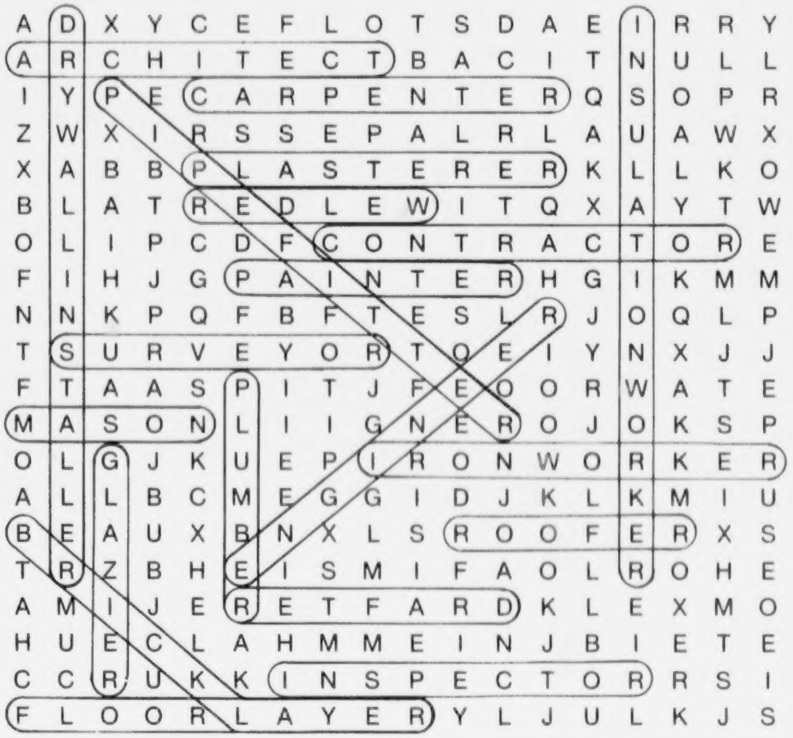
Directions: Use grid paper provided by your instructor to design a model house to be built of cardboard. Work in small groups or as directed by your instructor.

INTRODUCTION TO CONSTRUCTION
UNIT I-C

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheets #1-#2 — Evaluated to the satisfaction of the instructor

Assignment Sheet #3



A	D	X	Y	C	E	F	L	O	T	S	D	A	E	I	R	R	Y
A	R	C	H	I	T	E	C	T	B	A	C	I	T	N	U	L	L
I	Y	P	E	C	A	R	P	E	N	T	E	R	Q	S	O	P	R
Z	W	X	I	R	S	S	E	P	A	L	R	L	A	U	A	W	X
X	A	B	B	P	L	A	S	T	E	R	E	R	K	L	L	K	O
B	L	A	T	R	E	D	L	E	W	I	T	Q	X	A	Y	T	W
O	L	I	P	C	D	F	C	O	N	T	R	A	C	T	O	R	E
F	I	H	J	G	P	A	I	N	T	E	R	H	G	I	K	M	M
N	N	K	P	Q	F	B	F	T	E	S	L	R	J	O	Q	L	P
T	S	U	R	V	E	Y	O	R	T	O	E	I	Y	N	X	J	J
F	T	A	A	S	P	I	T	J	F	E	O	O	R	W	A	T	E
M	A	S	O	N	L	I	I	G	N	E	R	O	J	O	K	S	P
O	L	G	J	K	U	E	P	I	R	O	N	W	O	R	K	E	R
A	L	L	B	C	M	E	G	G	I	D	J	K	L	K	M	I	U
B	E	A	U	X	B	N	X	L	S	R	O	O	F	E	R	X	S
T	R	Z	B	H	E	I	S	M	I	F	A	O	L	R	O	H	E
A	M	I	J	E	R	E	T	F	A	R	D	K	L	E	X	M	O
H	U	E	C	L	A	H	M	M	E	I	N	J	B	I	E	T	E
C	C	R	U	K	K	I	N	S	P	E	C	T	O	R	R	S	I
F	L	O	O	R	L	A	Y	E	R	Y	L	J	U	L	K	J	S

Assignment Sheets #4-#6 — Evaluated to the satisfaction of the instructor

ETE- 27-C

INTRODUCTION TO CONSTRUCTION
UNIT I-C

NAME __________________________ SCORE ____________________

TEST

1. Complete the following statements concerning the development of structures.

   a. Before history was recorded, people lived in ____________. These were shelters formed by nature.

   b. ____________ homes were shelters that developed as it became necessary to travel and search for food. Tents made from poles cut from trees and animal skins provided a shelter that could be taken apart quickly and carried from place to place.

   c. Once people learned to farm and produce their own food, the need to move around in search of food was no longer necessary. The first ____________ homes of sticks and mud were built. Eventually other materials were used. Later tools were developed to assist in construction.

   d. As people came together to live in ____________, their needs for structures changed. It became necessary to utilize space and provide safe structures for families. New construction technologies developed. Multiple floor dwellings developed. Foundations were needed to support layers of rooms.

2. Define construction technology. ____

   ____

   ____

3. Complete the following statements concerning how construction technology affects society by providing the correct words.

   a. Construction creates environmental problems when ____________ is polluted and ____________ ____________ are depleted.

   b. Construction makes life more comfortable by providing us comfortable ____________ and protecting us from the ____________.

   c. Construction must plan for the future by protecting natural ____________.

TEST

4. Complete the following statements concerning the types of construction by filling in the blanks with the correct words.

   a. ____________ construction includes the building of highways, railroads, pipelines, public utilities, water and sewer systems, dams, bridges, and electrical utilities.

   b. ____________ construction is concerned mainly with the building of homes, apartments, condominiums, and small commercial buildings.

   c. ____________ construction is primarily involved with the erection of commercial, industrial, educational, and institutional buildings.

5. Match the careers listed on the right with the correct definitions.

   _____a. Training requires 3-5 years of apprenticeship or vocational school training

   _____b. Training requires a degree from a college, an internship, and a license

   _____c. Training requires 2-4 years of specialization

   1. Professional
   2. Technical
   3. Skilled
   4. Unskilled

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

6. Identify the major types of construction in your community. (Assignment Sheet #1)

7. Research a construction technology career. (Assignment Sheet #2)

8. Complete a word search of construction careers. (Assignment Sheet #3)

9. Sketch a floor plan of a house. (Assignment Sheet #4)

10. List construction careers involved in building a house. (Assignment Sheet #5)

11. Design a cardboard model house. (Assignment Sheet #6)

INTRODUCTION TO CONSTRUCTION
UNIT I-C

ANSWERS TO TEST

1. a. Caves
   b. Movable
   c. Permanent
   d. Towns and cities (urban areas)

2. Definition of construction technology — The effective use of materials, labor, equipment, methods, and management resources to produce a structure on site.

3. a. Air, water, or land, natural resources
   b. Homes, elements (environment)
   c. Resources

4. a. Civil (and/or heavy)
   b. Residential (or light)
   c. Commercial

5. a. 3
   b. 1
   c. 2

6.-11. Evaluated to the satisfaction of the instructor.

DESIGNING AND PLANNING A STRUCTURE
UNIT II-C

UNIT OBJECTIVE

After completion of this unit, the student should be able to apply the construction system model to plan a construction project. Competencies will be demonstrated by completing the assignment sheets, job sheet, and unit tests with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to project planning with the correct definitions.
2. Categorize components of a construction system model.
3. Arrange in order the steps in the construction process.
4. Match construction materials with the correct uses.
5. Identify bridge types.
6. Complete a chart of units for measuring.
7. Identify graduations on a standard rule.
8. Read a rule. (Assignment Sheet #1)
9. Design a truss bridge. (Assignment Sheet #2)
10. Utilize the system model to design a construction project. (Assignment Sheet #3)
11. Demonstrate the ability to build and stress test a model truss bridge. (Job Sheet #1)

DESIGNING AND PLANNING A STRUCTURE
UNIT II-C

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

G. Provide students with job sheet.

H. Discuss and demonstrate the procedure outlined in the job sheet.

I. Integrate the following activities throughout the teaching of this unit:

  1. Bridge building is an AIASA competitive event. Consult Competition Events Guidelines for information. You may wish to encourage students to enter regional and state bridge building contests through an organized AIASA chapter.

  2. Provide the following equipment for testing the students' model truss bridges in Job Sheet #1.

    a. Testing frame

    b. Testing block

    c. Testing hook

    d. Two 5 gallon plastic pails

    e. 50 lbs clean sand

    f. Balance scales

    g. Calculator

    h. Evaluation sheet (Use Practical Test which follows the Job Sheet)

  3. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

J. Administer test.

K. Evaluate test.

L. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. *Industrial and Technical Education: A Guide for Curriculum Designers, Implementors, and Teachers.* Lansing, Illinois. Technical Foundation of America.

B. *Jackson's Mill Industrial Arts Curriculum Theory.* Charleston, West Virginia. West Virginia Department of Educaion.

C. *Competitive Events Guidelines*, revised edition. Reston, VA. National AIASA, 1985.

D. Feirer, John L. and John R. Lindbeck. *Production Technology.* Peoria, IL: Bennett and McKnight Publishing Company, 1986.

E. Williams, Charles F., Kamiran S. Badrkhan, and Willard K. Daggett. *Technology for Tomorrow.* Cincinnati, OH: South-Western Publishing Company, 1985.

F. Henak, Richard M. *Exploring Construction.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1985.

SUGGESTED SUPPLEMENTAL MATERIALS

A. **The Other Bridge** — Video 1/2", color, 27 minutes, 1984.

Explores the construction, design, and operation of the San Francisco-Oakland Bay Bridge. Includes an in-depth look at the world of engineering and design. Available from:

Centre Productions, Inc.
1800 30th St., #207
Boulder, CO 80301
1-800-824-1166

B. **Monument to a Dream,** VHS video or film, free loan.

Story of the construction of the St. Louis arch. Available from:

Jefferson National Expansion Memorial
11 North 4th Street
St. Louis, MO 63102

DESIGNING AND PLANNING A STRUCTURE
UNIT II-C

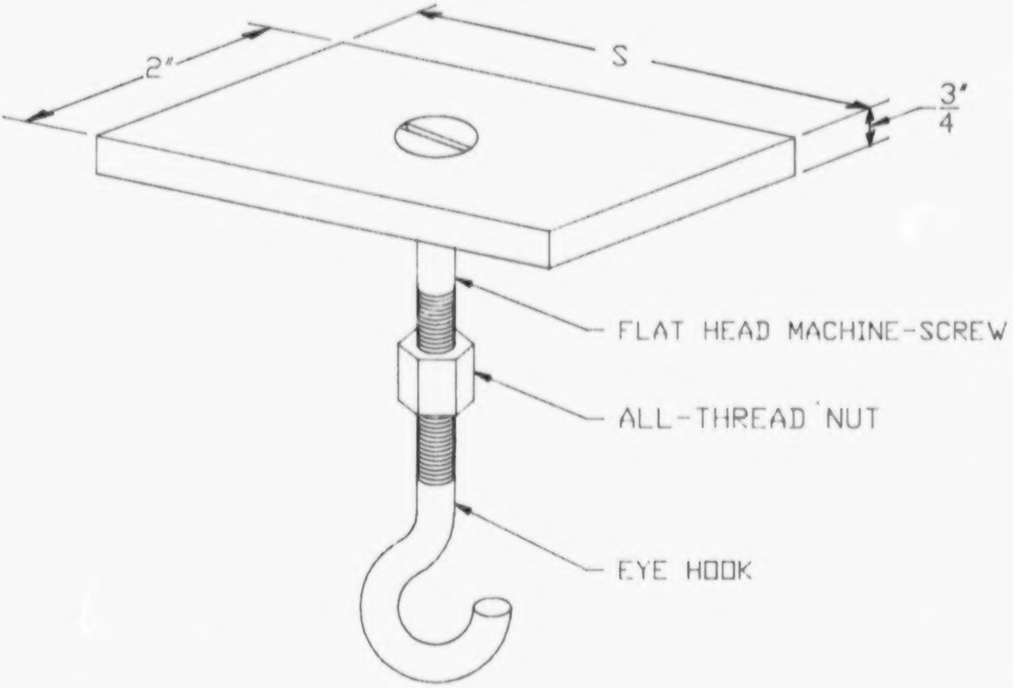
TEACHER SUPPLEMENT #1 — TEST BLOCK SPECIFICATIONS

(NOTE: This test system is for concentrated stress testing.)

A. Bridge must accommodate test block on the roadbed and allow for the bolt to protrude through the bottom of the bridge. (S is the length of the span minus 2".)

B. After the block is in place, the hook will be attached and a load can then be applied to the hook.

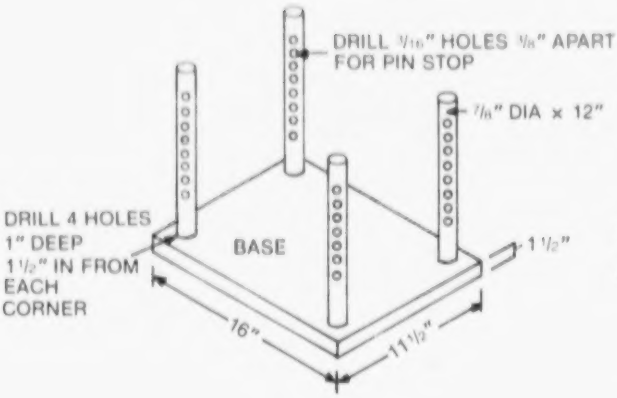
NOTE:
'S' IS THE LENGTH
OF THE SPAN MINUS 2".

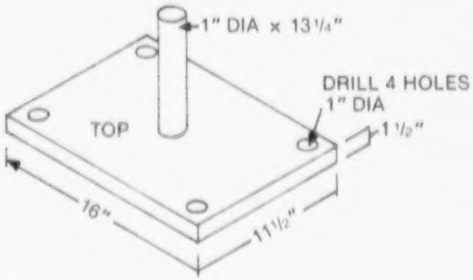

2"
S
3/4"
FLAT HEAD MACHINE-SCREW
ALL-THREAD NUT
EYE HOOK

DESIGNING AND PLANNING A STRUCTURE
UNIT II-C

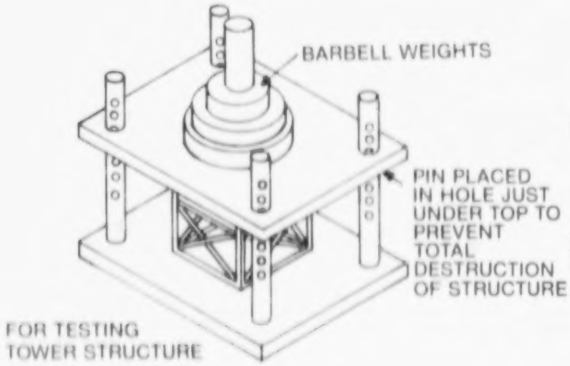
TEACHER SUPPLEMENT #2 — ALTERNATE TRUSS BRIDGE STRESS TEST

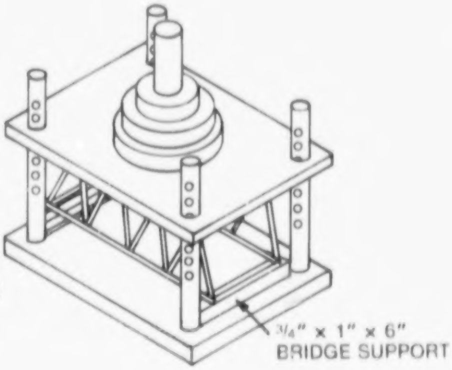
(NOTE: This test system is for uniform load testing.)


DRILL 5/16" HOLES 5/8" APART FOR PIN STOP
7/8" DIA × 12"
DRILL 4 HOLES 1" DEEP 1 1/2" IN FROM EACH CORNER
BASE
1 1/2"
16"
11 1/2"


1" DIA × 13 1/4"
DRILL 4 HOLES 1" DIA
TOP
1 1/2"
16"
11 1/2"

Remember to add the weight of the top to the total load placed on the structure. Bridge supports should be located at the point that is given in the problem as the distance the bridge has to span.


BARBELL WEIGHTS
PIN PLACED IN HOLE JUST UNDER TOP TO PREVENT TOTAL DESTRUCTION OF STRUCTURE
FOR TESTING TOWER STRUCTURE


3/4" × 1" × 6" BRIDGE SUPPORT

Construction Idea: 2×12 could be used for the construction of the base and top of the "structure crusher." Two 3/4" pieces of plywood will also work if they are laminated together.

DESIGNING AND PLANNING A STRUCTURE
UNIT II-C

INFORMATION SHEET

I. **Terms and definitions**

   A. Bridge — A structure carrying a pathway or roadway over a depression or obstacle

   B. Cement — A powderlike substance that when mixed with water is used as a binding ingredient of mortar and concrete

   C. Concrete — A hard, strong building material made by mixing a cementing material (such as portland cement) and an aggregate (such as sand and gravel) with sufficient water to cause the cement to set and bind the entire mass

   D. Laminated — Composed of layers of firmly united material

   E. Masonry — The use of stonework and brickwork for construction

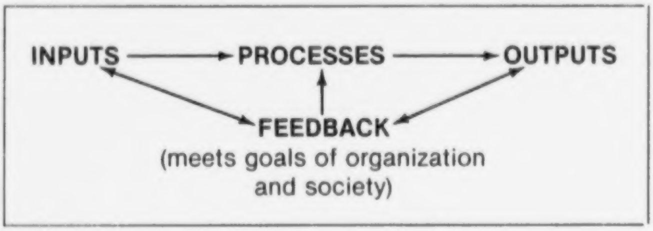
   F. Mortar — A mixture of lime, cement, sand, and water used to hold blocks or bricks together

   G. Stress test — To apply pressure or weight to the point of collapse

   H. Working drawing — A drawing or sketch giving dimensions and other needed information for construction

INFORMATION SHEET

II. The construction system model



INPUTS

- People
  - Skills
  - Attitudes
  - Knowledge (personal)
- Knowledge (accumulated)
- Materials
- Energy
- Capital (plant and equipment)
- Finance (money)

PROCESSES

PRODUCTIVE
- Preparing to build
- Designing the project
- Building the structure
- Installing systems
- Finishing the project
- Completing the site and closing contracts
- Servicing the project

MANAGERIAL
- Planning
- Organizing
- Directing
- Controlling

OUTPUTS

- Structure is on site
  - Residential/light
  - Commercial/industrial
  - Civil/heavy

III. Steps in the construction process (Transparencies 1 and 2)

A. Prepare to build.

1. Obtain the site.
2. Survey the site.
3. Secure permit.

B. Design the project.

1. Collect ideas for project.
2. Select project.
3. Make working drawings.
4. Estimate cost.

INFORMATION SHEET

  5. Hire workers.
  6. Order materials and equipment.

C. Build the structure.
  1. Clear the site.
    a. Do earthwork.
    b. Locate the structure.
  2. Build the foundation.
  3. Frame structure.
  4. Enclose roof.
  5. Enclose openings and exterior walls.

D. Install systems.
  1. Heating, ventilating, and air conditioning (HVAC) systems
  2. Plumbing
  3. Electrical
  4. Solar

E. Finish the project.
  1. Outside trim
  2. Paint and wall covering
  3. Ceiling and floor finishing
  4. Plumbing and electrical fixtures
  5. Interior trim
  6. Landscape planning

F. Close the contract.
  1. Final inspections
  2. Certificate of completion

(NOTE: Throughout the construction process the structure must be protected and the tools and equipment must be serviced and maintained.)

INFORMATION SHEET

IV. **Materials used in construction** (Transparencies 3-6)

A. Concrete (Transparency 3)

1. One of the most important building materials

2. Provides a strong mass

3. Used for footings, foundations, and walls

B. Wood (Transparency 4)

1. Lumber — Comes in the form of boards to be used for framing, sheathing, siding, flooring, and trim.

   (NOTE: Grading is used to describe the quality of lumber. Quality is determined by appearance and strength.)

2. Plywood — Comes in 4′×8′ panels and is used as support and to decorate structures as sheathing, roof decks, and subfloors.

3. Laminated timbers — Made from lumber that is glued together and used for arches, poles, and beams.

4. Engineered panels — Modified wood products bonded with glue and formed into boards.

   Examples: Wafer, particle, or fiber board

5. Pressure-treated wood — Specially-treated wood to protect against decay, mold, and insects.

C. Metal (Transparency 5)

1. Steel — Very strong metal (iron alloy); primarily used for structural frames.

2. Aluminum — Light metal that has good electrical and thermal conductivity, high reflectivity, and resistance to oxidation; generally for exterior use.

3. Copper — A reddish metal that is easily worked and joined and is an excellent electrical and thermal conductor; commonly used for plumbing and roofing.

D. Masonry materials — Primarily used for exterior and interior walls (Transparency 6)

1. Clay — One of the oldest manufactured building materials that can be formed into bricks (solid) or tiles (hollow).

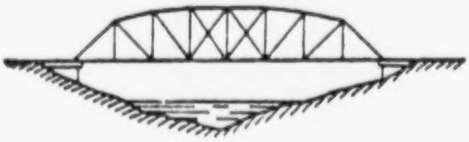
INFORMATION SHEET

2. Concrete — Made from specially-mixed cement that can be formed into both bricks and blocks.

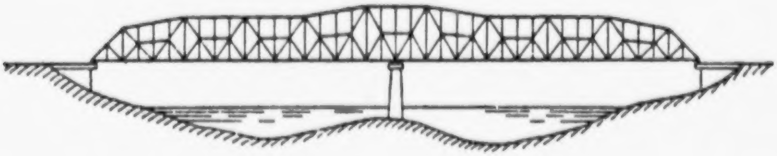
   (NOTE: Masonry units are commonly joined with mortar.)

V. **Types of bridges**

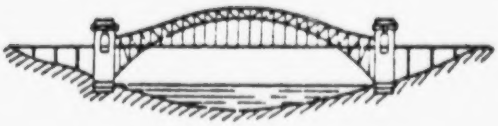
A. Simple truss (Transparency 7)



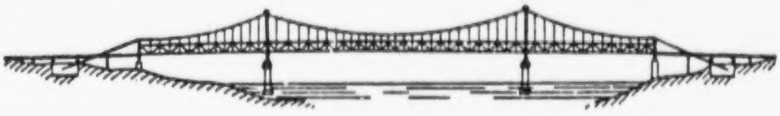
B. Continuous truss



C. Arch



D. Suspension



(NOTE: Many materials can be used to construct a bridge including wood, masonry, iron, steel, and reinforced concrete.)

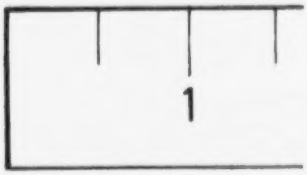
INFORMATION SHEET

VI. Units for measuring

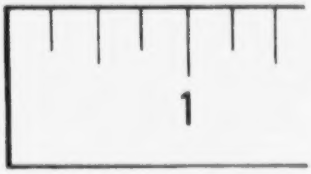
Measurement	Customary Units	
A. Length or distance	inch foot	yard mile
B. Mass or weight	ounce pound ton	
C. Volume	fluid ounce cup pint cubic inch cubic foot	quart gallon cubic yard
D. Area	square inch square foot square yard	acre square mile

VII. Graduations on a standard rule (linear measurement) (Transparency 8)

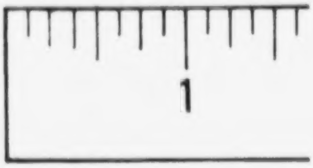
A. Halves



B. Quarters

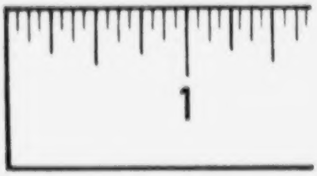


C. Eighths

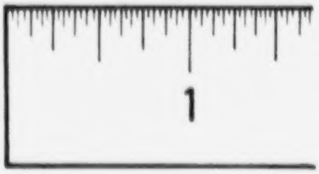


INFORMATION SHEET

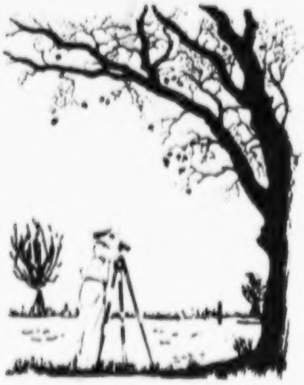
D. Sixteenths



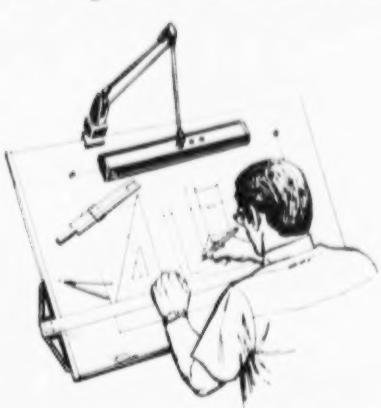
E. Thirty-seconds



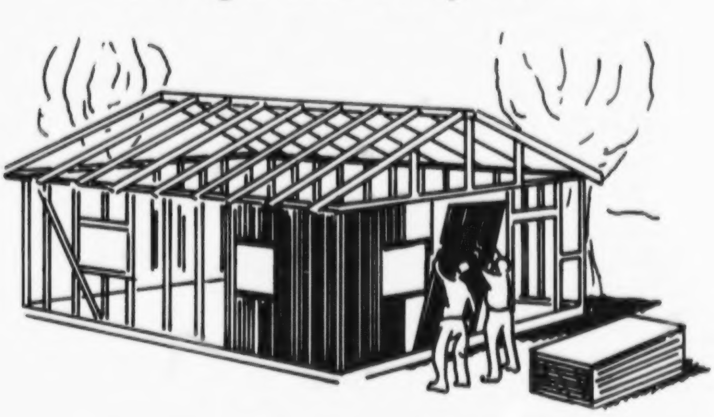
Steps in the Construction Process



Prepare to Build



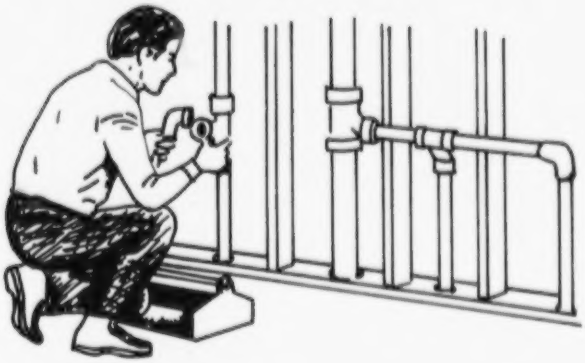
Design the Project



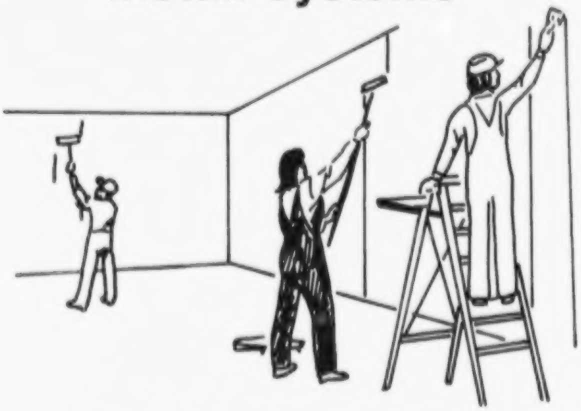
Build the Structure

Steps in the Construction Process

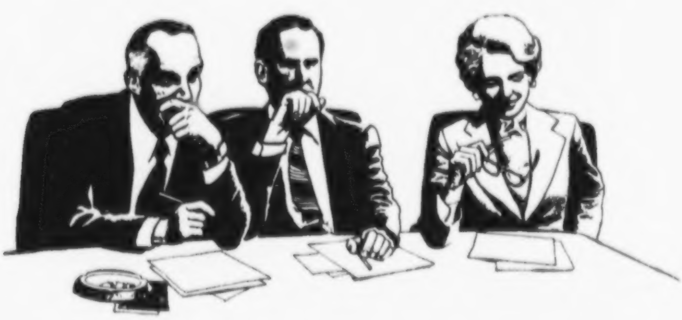
(Continued)



Install Systems

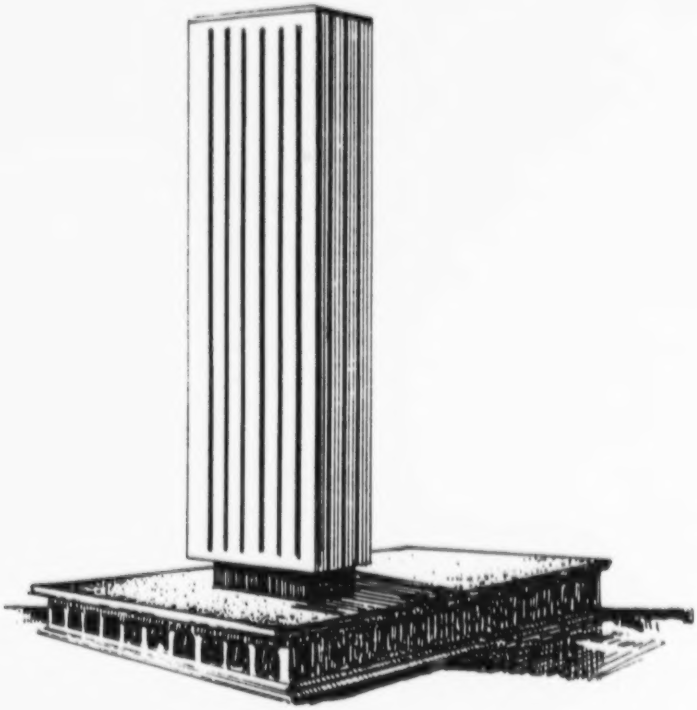


Finish the Project



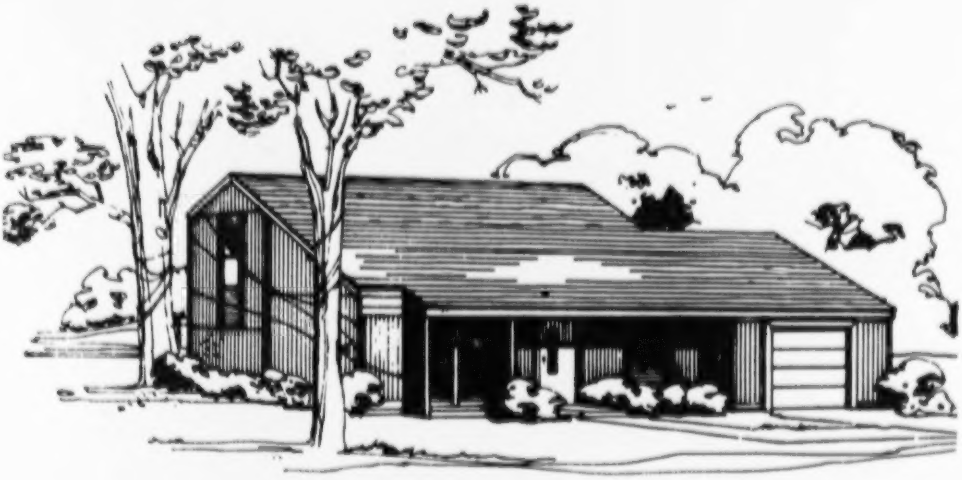
Close the Contract

Reasons for Using Concrete



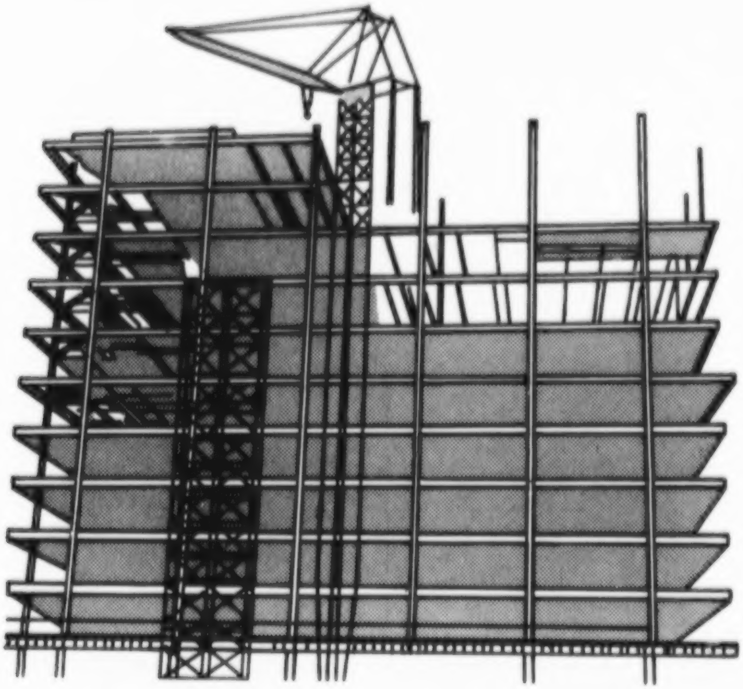
1. Adaptable and serviceable in a variety of situations
2. Permanent when properly made
3. Sanitary and easily cleaned
4. More fireproof than other building materials
5. Economical in installation and in maintenance
6. Easy to use

Reasons for Using Wood



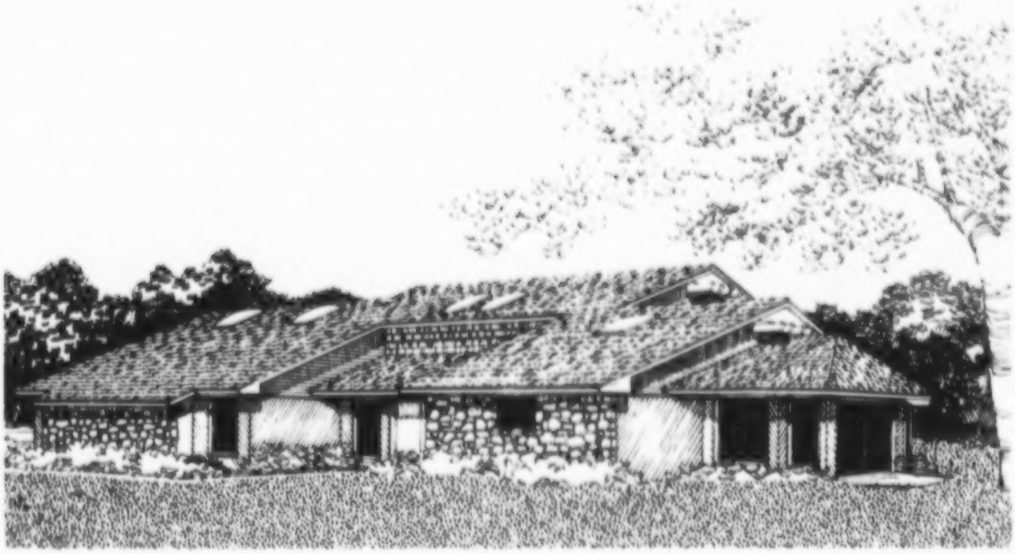
1. Strong and durable
2. Adaptable
3. Easy to use
4. Readily available and renewable
5. Looks warm and natural

Reasons for Using Metal



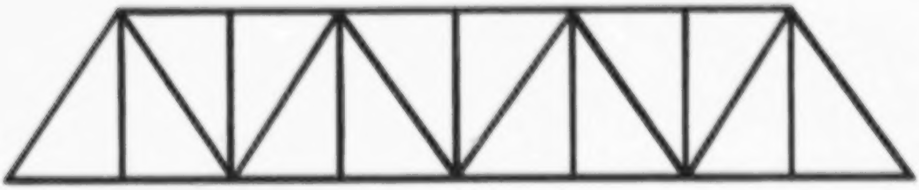
1. Very long lasting with low-maintenance needs
2. Fireproof
3. Steel is very strong
4. Readily available

Reasons for Using Masonry Materials

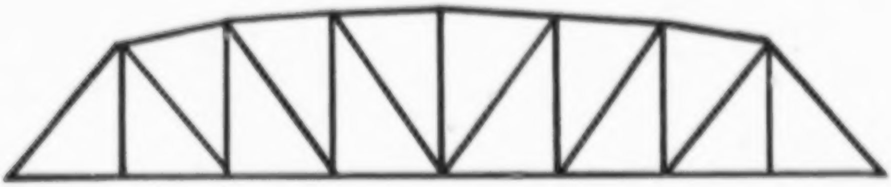


1. Long lasting with low maintenance needs
2. Strong
3. Fireproof
4. Natural looking
5. Provide architectural interest

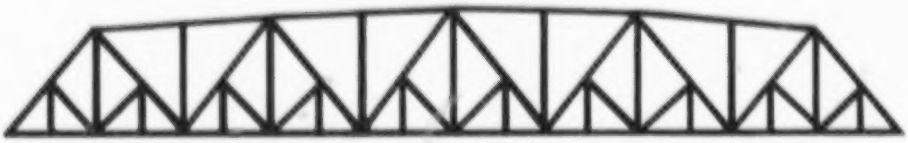
Simple Trusses



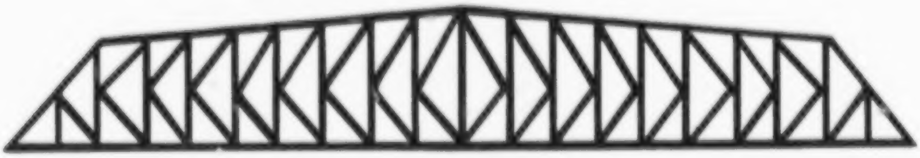
Warren Truss



Pratt Truss

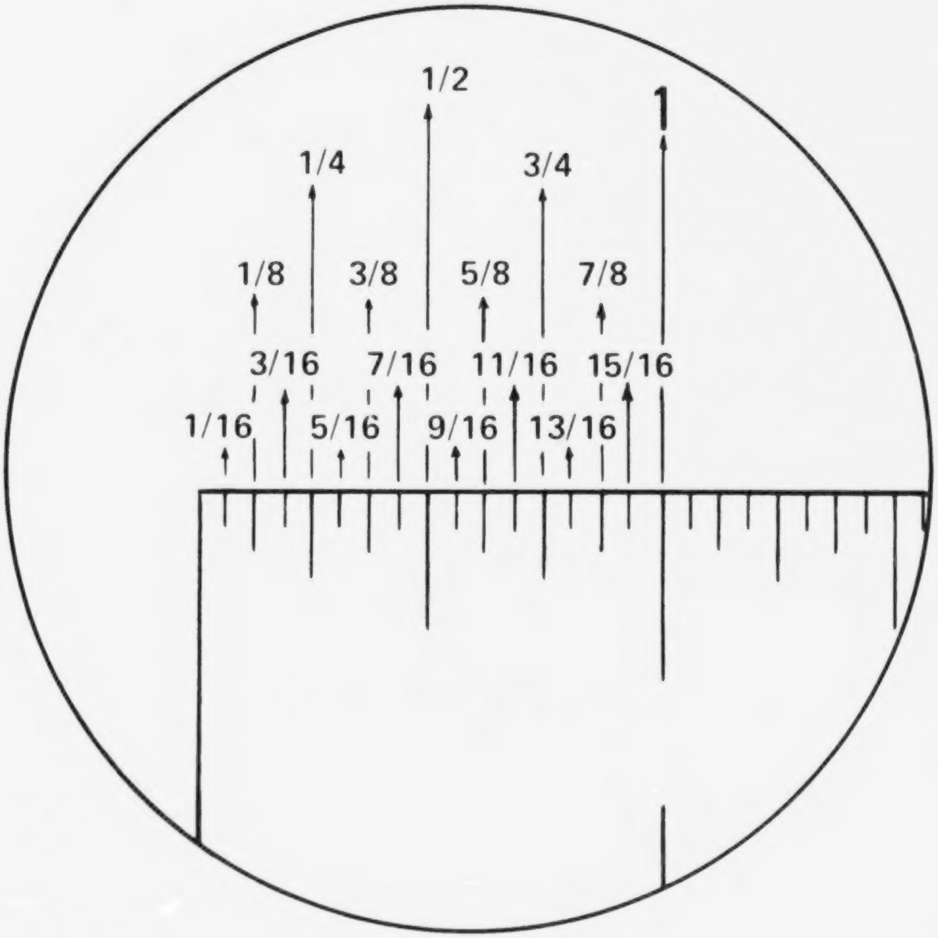


Subdivided Warren Truss



K-Truss

Graduations Applied to a Rule


1/2
1
1/4
3/4
1/8
3/8
5/8
7/8
3/16
7/16
11/16
15/16
1/16
5/16
9/16
13/16

DESIGNING AND PLANNING A STRUCTURE
UNIT II-C

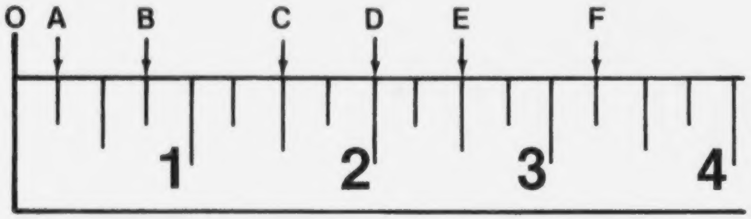
ASSIGNMENT SHEET #1 — READ A RULE

NAME ____ SCORE ____________

Almost every piece of stock must be measured before cutting for use. If your project is to be accurate, you must be able to make accurate measurements.

PART I

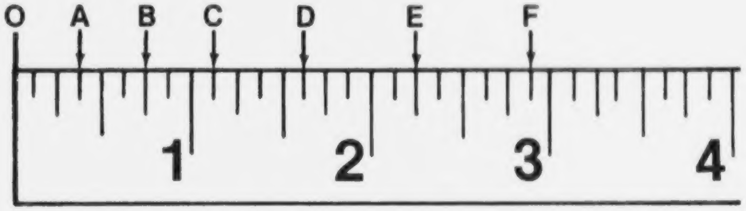
A. Using the drawing below, read the rule to the nearest one-fourth inch. Write the answers in the blanks in their simplest terms.



1. O-A ____________
2. O-B ____________
3. O-C ____________
4. O-D ____________
5. O-E ____________
6. O-F ____________

ASSIGNMENT SHEET #1

B. Using the drawing below, read the rule to the nearest one-eighth inch. Write the answers in the blanks in their simplest terms.



1. O-A
2. O-B
3. O-C
4. O-D
5. O-E
6. O-F

PART II

Directions: Shown below are some lines. Practice your measuring skill and write the correct measurement on each line.

A. ______________

B. ____________________________

C. ______________________________

D. ________________________________

E. ____

F. ____

G. _____________________

H. ____

I. _________________________

DESIGNING AND PLANNING A STRUCTURE
UNIT II-C

ASSIGNMENT SHEET #2 — DESIGN A TRUSS BRIDGE

NAME ______________________________ SCORE ____________

Engineers use many clever ways to give strength to a structure. A project must be strong enough to withstand the forces of nature.

Examples:
1. A dam must withstand great pressure from water.
2. Skyscrapers must withstand strong winds and masses of weight.
3. Pipelines must withstand pressure from within.
4. Bridges must be built where there are no places to build foundations and must withstand the elements and weight masses.

Direction: Plan to design the bridge by using the problem-solving steps.

A. Identify the problem

B. Collect ideas

C. Decide on a solution

D. Analyze the solution

E. Implement the solution

(NOTE: Bridges must be designed in such a manner as to accommodate a test hook at the bridge's center (see instructor). Amount of wood glue will not be indicated but do not plan to laminate joints.)

With a lab partner form a team to design a truss bridge to be built with 1/8" balsa wood within the following limits:

Span:	12"
Width:	3"

Sketch your design on 1/4" grid paper.

DESIGNING AND PLANNING A STRUCTURE
UNIT II-C

ASSIGNMENT SHEET #3 — DESIGN A STRUCTURE

NAME ______________________________ SCORE ____________

Directions: Refer to the system model in the Information Sheet and apply problem-solving techniques while selecting a construction project.

(NOTE: Work in groups or individually as directed by instructor.)

A. Collect ideas for a construction project.

Examples: Club house, scale model house (dream house), portable storage building, dollhouse

B. Consider the following:

1. Function — Will the project do what it is supposed to do?
2. Appearance — Will the project look good and fit in with the setting around it?
3. Cost — Will the project be within the budget?
4. Strength — Will the project withstand the forces that it will be subjected to?
5. Materials — Which materials will be the best to use and are they available?

C. Select construction project.

D. Make or obtain a working drawing. This drawing or sketch must have dimensions on it.

ASSIGNMENT SHEET #3

E. Complete the following planning sheet (bill of materials).

PLANNING SHEET

Name ______________________ **Grade**__________

____

Name of the Project **Date Started** **Date Completed**

Bill of Materials:

No. of Pieces Needed	Thickness	Width	Length	Name of Part	Material	Unit Cost	Total Cost

ASSIGNMENT SHEET #3

F. Estimate cost based on planning sheet and instructor's directions.

G. Make list of tools and machines needed for project.

(CAUTION: Safety test must be completed and on file before using tools and equipment.)

H. Make job assignments.

(NOTE: Follow instructor's directions.)

I. Order materials and equipment.

(NOTE: Follow instructor's directions.)

DESIGNING AND PLANNING A STRUCTURE
UNIT II-C

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

PART I

A. 1. 1/4"
   2. 3/4"
   3. 1 1/2"
   4. 2"
   5. 2 1/2"
   6. 3 1/4"

B. 1 3/8"
   2. 3/4"
   3. 1 1/8"
   4. 1 5/8"
   5. 2 1/4"
   6. 2 7/8"

PART II

A. 1 1/2"

B. 3"

C. 3 1/4"

D. 3 1/2"

E. 4 1/4"

F. 5 1/4"

G. 2 1/4"

H. 4 3/4"

I. 2 3/4"

Assignment Sheet #2 — Evaluated to the satisfaction of the instructor

Assignment Sheet #3 — Evaluated to the satisfaction of the instructor

DESIGNING AND PLANNING A STRUCTURE
UNIT II-C

JOB SHEET #1 — BUILD AND STRESS TEST A MODEL TRUSS BRIDGE

A. Tools and materials

1. Balsa wood strips, 1/8" × 1/8"
2. White glue
3. Cutting surface
4. Single edge razor blade
5. Straight pins
6. Ruler, 12"

(NOTE: Testing equipment will be provided by instructor.)

B. Procedure

1. Follow instructor's directions for setting up work area.
2. Using design from Assignment Sheet #2, cut strips of wood for trusses.
3. Construct bridge by joining the wood pieces together with the white glue.
4. Use straight pins to hold glue joints together until dry.
5. Store bridge in drying area and clean up work area.
6. Allow to dry a minimum of 18 hours.
7. Measure and record amount of wood used in the construction of the bridge.
8. Measure and record width and span.
9. Test bridge according to instructor's directions.
10. Calculate efficiency using the following formula and evaluate by AIASA competitive event guidelines:

$$\text{Efficiency} = \frac{\text{Failure Weight}}{\text{Length of wood used}}$$

11. Clean up test area.

DESIGNING AND PLANNING A STRUCTURE
UNIT II-C

PRACTICAL TEST
JOB SHEET #1 — BUILD AND STRESS TEST A MODEL TRUSS BRIDGE

STUDENT'S NAME ______________________________ DATE __________

EVALUATOR'S NAME ______________________________ ATTEMPT NO. _____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the material and try again.)

The student:	YES	NO
1. Checked out proper tools and materials.	____	____
2. Followed instructor's direction.	____	____
3. Followed design well.	____	____
4. Used cutting tool safely.	____	____
5. Measured and recorded amount of wood.	____	____
6. Measured and recorded width and span of bridge.	____	____
7. Tested bridge as instructed.	____	____
8. Worked well as a team member.	____	____
9. Checked in/put away tools and materials.	____	____
10. Cleaned the work area.	____	____
11. Used proper tools correctly.	____	____
12. Performed steps in a timely manner. (___hrs.___min.___sec.)	____	____
13. Practiced safety rules throughout procedure.	____	____
14. Provided satisfactory responses to questions asked.	____	____

EVALUATOR'S COMMENTS: ____

____

PRACTICAL TEST

JOB SHEET #1

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Neatness	4	3	2	1
Strength	4	3	2	1
Followed plans	4	3	2	1
Met specifications	4	3	2	1

EVALUATOR'S COMMENTS: ____________________

PERFORMANCE EVALUATION KEY

4 — Skilled — Can perform job with no additional training.
3 — Moderately skilled — Has performed job during training program; limited additional training may be required.
2 — Limited skill — Has performed job during training program; additional training is required to develop skill.
1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR'S NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

DESIGNING AND PLANNING A STRUCTURE
UNIT II-C

NAME ______________________________ SCORE ________________________

TEST

1. Match the terms on the right with the correct definitions.

_____a. A hard, strong building material made by mixing a cementing material and an aggregate with sufficient water to cause the cement to set and bind the entire mass

_____b. A structure carrying a pathway or roadway over a depression or obstacle

_____c. The use of stonework and brickwork for construction

_____d. Composed of layers of firmly united material

_____e. A mixture of lime, cement, sand, and water used to hold blocks or bricks together

_____f. To apply pressure or weight to the point of collapse

_____g. A drawing or sketch giving dimensions and other needed information for construction

_____h. A powderlike substance that when mixed with water is used as a binding ingredient of mortar and concrete

1. Bridge
2. Cement
3. Concrete
4. Clay
5. Laminated
6. Masonry
7. Copper
8. Mortar
9. Stress test
10. Brick
11. Working drawing
12. Elevation drawing
13. Aluminum
14. Glass

TEST

2. Categorize the components of a construction system model by placing the following letters in the appropriate blanks:

- I — Inputs
- P — Processes
- O — Outputs

_____a. Designing the project

_____b. Installing systems

_____c. Materials and energy

_____d. Structure is on site

_____e. Knowledge

_____f. Finance and capital

_____g. Preparing to build

_____h. People

3. Arrange in order the steps in the construction process by placing the correct sequence numbers (1-6) in the appropriate blanks.

_____a. Design the project.

_____b. Finish the project.

_____c. Build the structure.

_____d. Close the contact.

_____e. Prepare to build.

_____f. Install systems.

TEST

4. Match the construction materials on the right with their correct uses.

______a. Comes in 4' × 8' panels and is used as support and to decorate structures as sheathing, roof decks, and subfloors.

______b. Comes in the form of boards to be used for framing, sheathing, siding, flooring, and trim.

______c. A reddish metal that is easily worked and joined and is an excellent electrical and thermal conductor; commonly used for plumbing and roofing.

______d. Specially-treated wood to protect against decay, mold, and insects.

______e. One of the oldest manufacturing building materials that can be formed into bricks (solid) or tiles (hollow).

______f. Light metal that has good electrical and thermal conductivity, high reflectivity, and resistance to oxidation; generally for exterior use.

______g. Made from lumber that is glued together and used for arches, poles, and beams.

______h. Very strong metal (iron alloy); primarily used for structural frames.

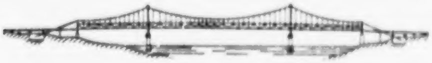
______i. Modified wood products bonded with glue and formed into boards.

______j. One of the most important building materials which is made from specially-mixed cement that can be formed into both bricks and blocks. Provides a strong mass for use in footings, foundations, and walls.

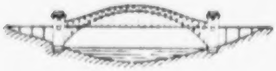
1. Aluminum
2. Clay
3. Concrete
4. Copper
5. Laminated timbers
6. Cement
7. Lumber
8. Pine
9. Engineered panels
10. Plastic
11. Plywood
12. Iron
13. Pressure-treated wood
14. Trees
15. Steel

TEST

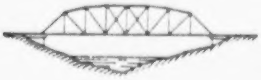
5. Identify the following bridge types.



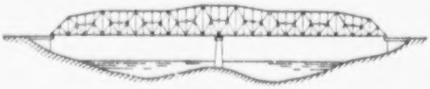
a. ______________________________



b. ______________________________



c. ______________________________



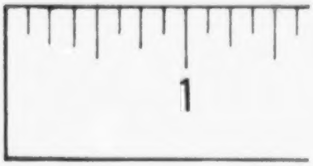
d. ______________________________

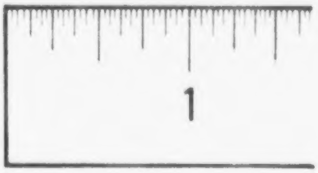
6. Complete the following chart of units for measuring.

Measurement	Customary Units
a. Length or distance	______________________
b. Mass or weight	______________________
c. ______________________	fluid ounce, cup, pint, quart, gallon, cubic inch, cubic foot, cubic yard
d. ______________________	square inch, square foot, square yard, acre, square mile

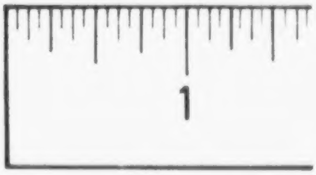
TEST

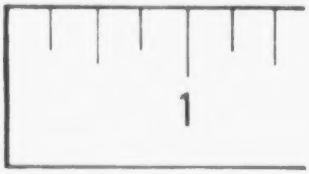
7. Identify the following graduations on a standard rule.



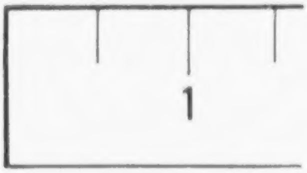


a. ______________________ b. ______________________





c. ______________________ d. ______________________



e. ______________________

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

8. Read a rule. (Assignment Sheet #1)

9. Design a truss bridge. (Assignment Sheet #2)

10. Utilize the system model to design a construction project. (Assignment Sheet 3)

11. Demonstrate the ability to build and stress test a model truss bridge. (Job Sheet #1)

DESIGNING AND PLANNING A STRUCTURE
UNIT II-C

ANSWERS TO TEST

1. a. 3
   b. 1
   c. 6
   d. 5
   e. 8
   f. 9
   g. 11
   h. 2

2. a. P
   b. P
   c. I
   d. O
   e. I
   f. I
   g. P
   h. I

3. a. 2
   b. 5
   c. 3
   d. 6
   e. 1
   f. 4

4. a. 11
   b. 7
   c. 4
   d. 13
   e. 2
   f. 1
   g. 5
   h. 15
   i. 9
   j. 3

5. a. Suspension
   b. Arch
   c. Simple truss
   d. Continuous truss

6. a. Inch, foot, yard, mile
   b. Ounce, pound, ton
   c. Volume
   d. Area

7. a. Eighths
   b. Thirty-seconds
   c. Sixteenths
   d. Quarters
   e. Halves

8.-10. Evaluated to the satisfaction of the instructor

11. Performance skills evaluated to the satisfaction of the instructor

BUILDING THE STRUCTURE
UNIT III-C

UNIT OBJECTIVE

After completion of this unit, the student should be able to participate as a team member on the building of a project. Competencies will be demonstrated by completing the job sheets and unit tests with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to building a structure with the correct definitions.
2. Select factors to be considered in clearing a construction site.
3. List methods used to clear a site.
4. Select correct general safety rules for using earthmoving equipment.
5. Match terms related to concrete with their correct definitions.
6. Match concrete ingredients with their ratios used in mixing.
7. Identify tools and equipment used in concrete work.
8. Identify types of concrete footings and foundations.
9. Identify tools and equipment used in general construction.
10. List precautions to follow in the care of tools.
11. Select true statements concerning personal safety rules.
12. Select true statements concerning rules for laboratory safety and maintenance.

OBJECTIVE SHEET

13. Identify parts of a floor frame.

14. Identify parts of a wall frame.

15. Identify parts of a roof frame.

16. Demonstrate the ability to:

    a. Prepare a site. (Job Sheet #1 or #2)

    b. Construct forms for concrete. (Job Sheet #3)

    c. Perform a slump test. (Job Sheet #4)

    d. Mix and finish concrete. (Job Sheet #5)

    e. Build a structure. (Job Sheet #6)

BUILDING THE STRUCTURE
UNIT III-C

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies (or larger posters) from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information sheet.

F. Discuss information sheet.

G. Provide students with job sheets.

H. Discuss and demonstrate the procedure outlined in the job sheets.

I. Integrate the following activities throughout the teaching of this unit:

1. The concrete projects completed in this unit could serve as a way to promote good will for your program by building sidewalks, stepping stones, or park benches for the school system, a civic organization, or city park.

2. You may wish to select a building project such as a portable storage building or club house that could be sold after completion.

3. Discuss the use of the compression test for concrete. Demonstrate if possible.

4. Place obstacles for Job Sheet #2 prior to class. Develop a different situation for each group.

5. Display safety posters that deal with construction safety.

6. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

J. Administer test.

K. Evaluate test.

L. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Henak, Richard M. *Exploring Construction.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1985.

B. Hendrix, Laborn J."Bud". *Residential Carpentry.* Stillwater, OK: Oklahoma State Board of Vocational and Technical Education, 1985.

SUGGESTED SUPPLEMENTAL RESOURCES

Films

A. *The Foundation*

B. *Wood Shell*

Available from:

The University of Wisconsin
Bureau of Audio-Visual Instruction
P.O. Box 2093
Madison, Wisconsin 53701-2093

BUILDING THE STRUCTURE
UNIT III-C

INFORMATION SHEET

I. **Terms and definitions**

   A. Building permit — Permission to use the land

      (NOTE: Permits are needed to build, move, or destroy structures.)

   B. Zoning ordinances — Laws set by governments (usually city) to control land use

   C. Building codes — Government regulations (national, state, and local) that determine how a building is to be built; these regulations are primarily to protect the public's health and safety

   D. Survey — To determine the form and position of a tract of land

II. **Factors to be considered when clearing a construction site**

   A. Size of the building

   B. Time of year

   C. Annual rainfall and vegetation

   D. Natural obstacles

      Example: Rivers, streams, hills, mountains, caves

   E. Man-made obstacles

      Example: Roads, buildings, underground utility lines

   F. Location

      Example: City, urban, rural

   G. Position of the building on a site

      Example: Above ground or below ground

INFORMATION SHEET

III. Methods used to clear a site

- A. Earthmoving
  - 1. Shoveling
  - 2. Dredging
  - 3. Dozing
- B. Cutting
  - 1. Sawing — To remove trees, underbrush
  - 2. Chopping — To remove trees
- C. Demolition
  - 1. Blasting — Uses plastic explosives, dynamite
  - 2. Wrecking — Uses crawler tractor with blade, wrecking bar, wrecking balls
- D. Salvage
  - 1. Removing materials

    (NOTE: These materials should be kept in good condition.)
  - 2. Storing materials for selling
- E. Disposal
  - 1. Hauling away demolished material
  - 2. Burning material

    (NOTE: You must have a permit to burn.)

IV. General safety rules for using earthmoving equipment

- A. Safety helmets and safety glasses must be worn at all times.
- B. Before starting equipment, make sure all other workers are away from the machine.
- C. The engine should be turned off before making repairs on equipment.
- D. Only the operator should ride on the equipment.
- E. Do not leave equipment with the engine running.

INFORMATION SHEET

V. **Terms and definitions related to concrete**

A. Aggregates — Materials such as sand and gravel used to give bulk and body to concrete

(NOTE: Fine aggregates are materials under 1/4" in size; coarse aggregates are materials over 1/4" in size.)

B. Anchor bolts — Bolts embedded in concrete used to hold structural members in place

C. Cement — A powderlike substance that when mixed with water is used as a binding ingredient of mortar and concrete

D. Concrete — A hard, strong building material made by mixing a cementing material (such as portland cement) and an aggregate (such as sand and gravel) with sufficient water to cause the cement to set and bind the entire mass

E. Control joint — A cut made at least 1/3 of the way into the slab to make a weakened plane in the concrete (to control where cracking may occur)

F. Duplex nail — A double-headed fastener that can be easily removed

G. Expansion joint — A joint in a masonry or concrete unit used to provide for expansion or contraction of materials due mostly to changes in moisture content and temperature

H. Monolithic — Concrete members that are cast as a solid, continuous unit

I. Ready-mixed concrete — Concrete that when ordered is ready for pouring

J. Rebar — Steel bars of various sizes used to reinforce load-bearing concrete containing curves or bends

K. Reinforced concrete — Concrete containing steel reinforcement which increases the tensile strength of the concrete

L. Wire mesh reinforcement — Roll or sheet welded wire mesh used in flat concrete work such as floor slabs, pavements, and sidewalks

INFORMATION SHEET

VI. Ingredients and ratio used in mixing concrete

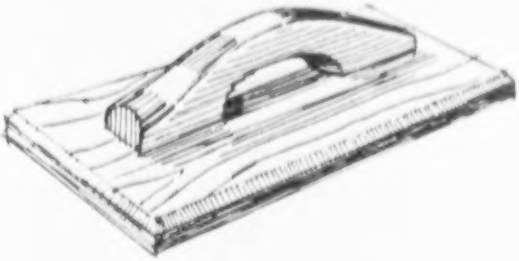
	Ingredients	Ratio
A.	Sand	Three parts
B.	Gravel (aggregate)	Four parts
C.	Cement	One part
D.	Water	Amount varies

(NOTE: Add water slowly. Too much water is as bad as too little water. Mix as water is added.)

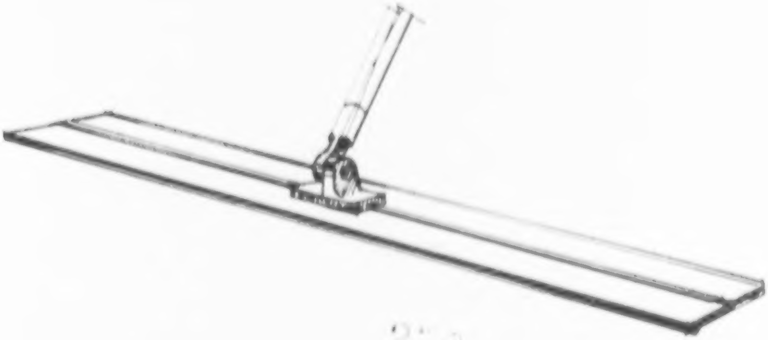
VII. Tools and equipment used in concrete work

A. Floats

1. Wood or metal — Prepares concrete for troweling



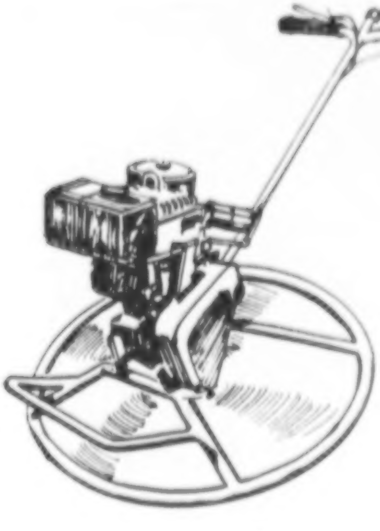
2. Bull float — Used to finish large areas



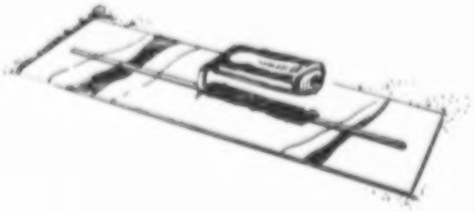
INFORMATION SHEET

B. Trowels

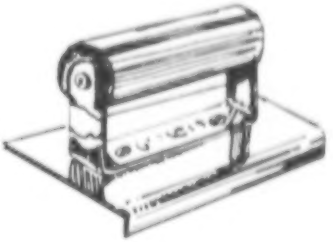
1. Power trowel — Gives a dense, smooth finish on slabs



2. Steel/hand trowel — Produces a smooth final finish

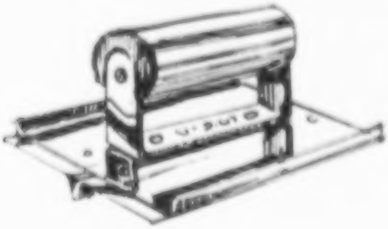


C. Edger — Makes a curve at the edge of the slab. Improves appearance and reduces the possibility of damage to the edges.

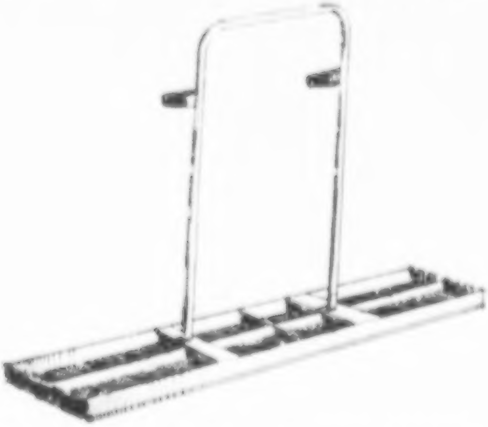


INFORMATION SHEET

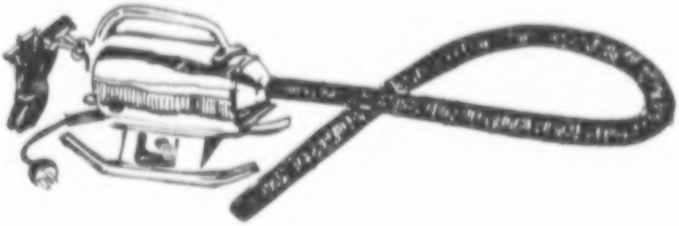
D. Jointer or groover — Cuts a joint partly through fresh concrete either for appearance or to control a joint



E. Jitterbug tamper — Forces the coarse aggregate slightly below the surface

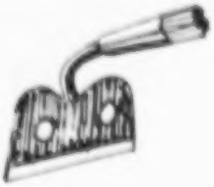


F. Electric concrete vibrator — Vibrates concrete to fill in air pockets and tamp aggregates

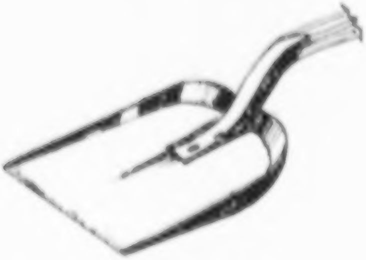


INFORMATION SHEET

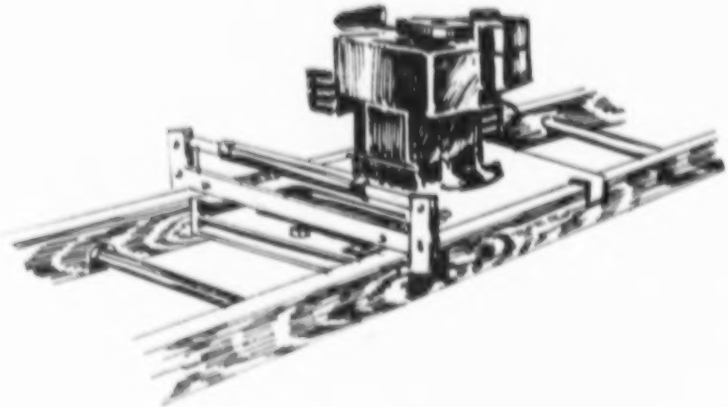
G. Hoe — Mixes sand, gravel, and cement together; repeats process when water is added



H. Shovel — Moves ready-mix concrete to the proper location in the forms

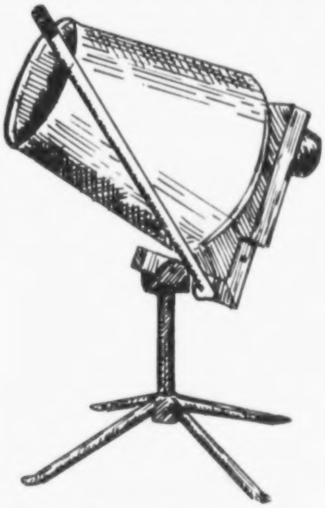


I. Vibrating screed — Vibrates in order to level, float, and settle concrete



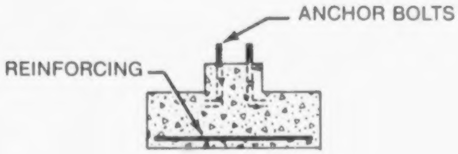
INFORMATION SHEET

J. Portable mixer — Mixes sand, gravel, cement, and water

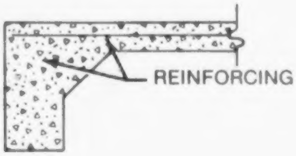


VIII. Types of concrete footings and foundations

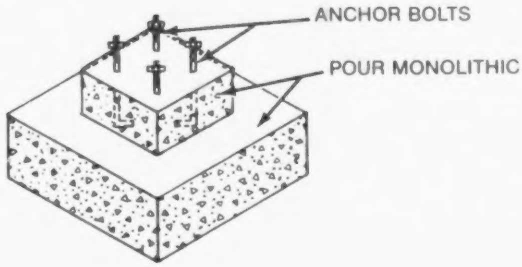
A. Spread footing


ANCHOR BOLTS
REINFORCING

B. Slab (on grade) poured monolithic


REINFORCING

C. Pier footing

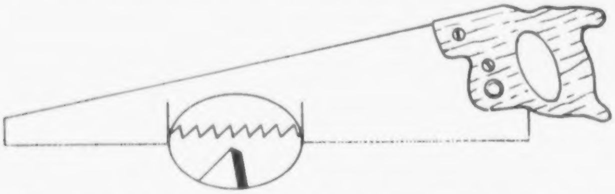

ANCHOR BOLTS
POUR MONOLITHIC

INFORMATION SHEET

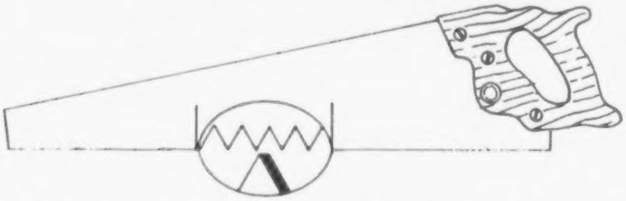
IX. Tools and equipment used in general construction

A. Hand saws

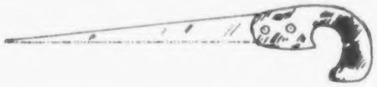
1. Crosscut saw — Used to cut across the grain of wood



2. Ripsaw — Used to cut with the grain of wood

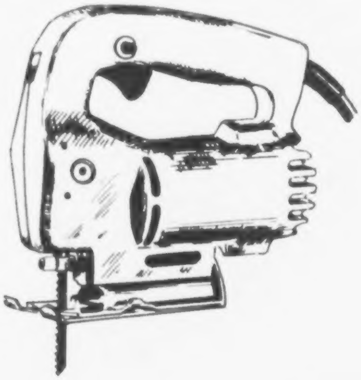


3. Compass saw — Used to cut curves



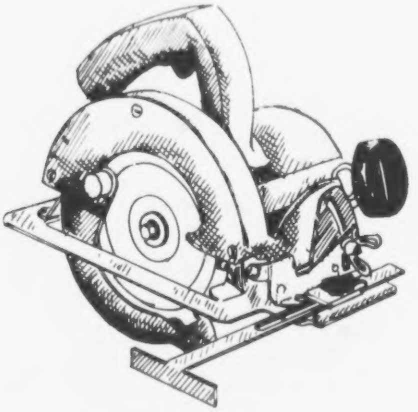
B. Power saws

1. Saber saw (jigsaw) — Multi-use saw used to make curve or scroll cuts as well as rip or crosscuts

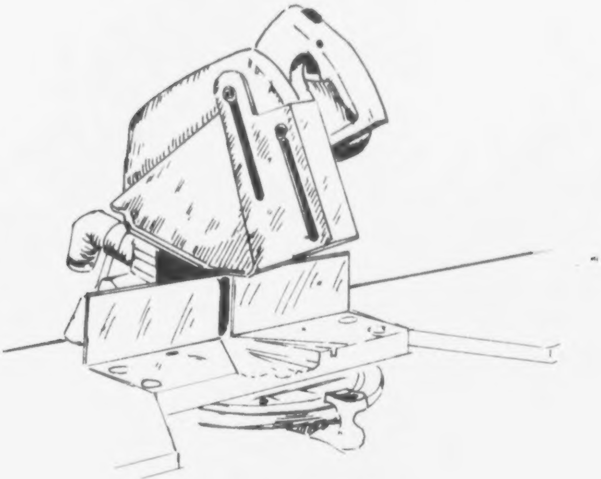


INFORMATION SHEET

2. Circular saw — Used for ripping, crosscutting and level cuts

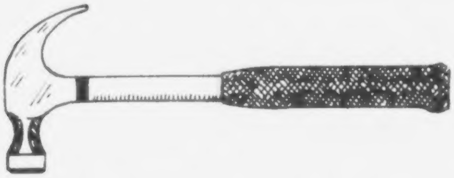


3. Power miter saw — Used to cut straight miters or crosscuts



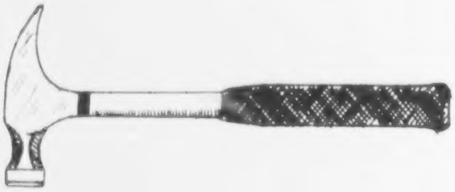
C. Claw hammers

1. Curved claw hammer — Used to drive or pull nails



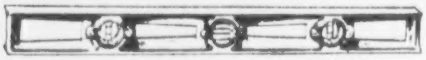
INFORMATION SHEET

2. Straight claw hammer — Used to drive nails, pull nails, dismantle, and wreck

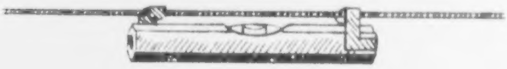


D. Levels

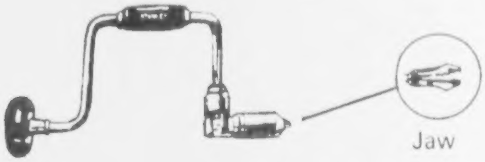
1. Carpenter's level — Used to check the trueness of vertical lines such as for walls, doors, and windows



2. Line level — Used to establish a true horizontal line

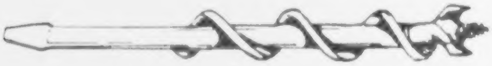


E. Brace — Used to hold auger bit to drill holes



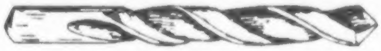
F. Bits

1. Auger bit — Used to drill holes in wood; must be used with a brace

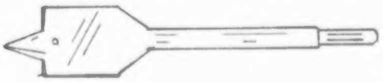


INFORMATION SHEET

2. Twist drill bit — Used to drill holes in wood; must be used with a hand drill or electric drill

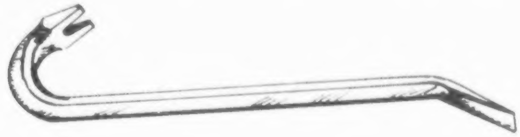


3. Power bit (flat bit, speed bit)

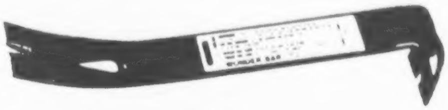


(NOTE: Other types of bits may be used such as expansive bits, lockset bits, or hole saw.)

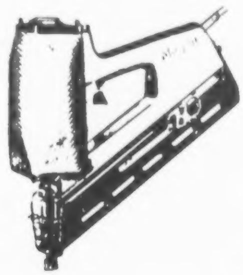
G. Wrecking bar — Strips concrete forms and pries or pulls nails



H. Pry bar — Used for pulling nails, prying, lifting, or scraping

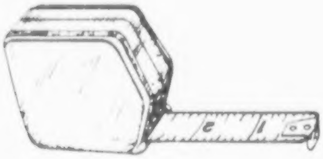


I. Power stapler — Used for stapling in construction framing, sub-flooring, sidewall sheathing, roof decking



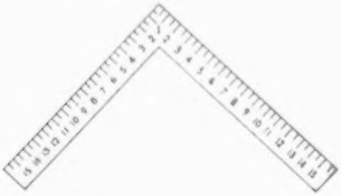
INFORMATION SHEET

J. Steel tape — Used to measure linear distances

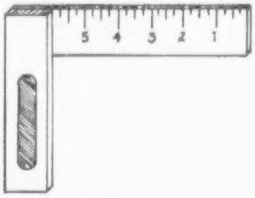


K. Squares

1. Steel framing square — Used to lay out rafters

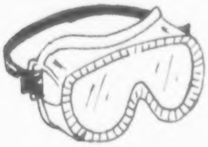


2. Try square — Used to check squareness of surfaces and edges and used to draw lines

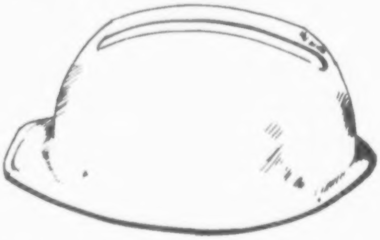


L. Safety equipment

1. Safety goggles or glasses



2. Safety helmet



(NOTE: Steel-reinforced safety shoes are also required on many construction sites.)

X. **Precautions to follow in the care of tools** (Transparencies 1 and 2)

A. Do not drop tools.

B. Keep tools clean.

C. Make sure tools are sharp.

D. Return tools to cabinet after use.

E. Keep tools dry and oiled.

F. Use tools only for the purpose intended.

INFORMATION SHEET

XI. **Personal safety rules**

A. Wear laboratory clothing appropriate to the instructional activity being performed.

B. Remove rings and other jewelry when working in the laboratory.

C. Conduct yourself in a manner conductive to safe laboratory practices.

D. Always wear safety glasses and safety helmets when needed.

E. Keep hands clean.

XII. **Rules for laboratory safety and maintenance**

A. Keep all hand tools sharp, clean, and in safe working order.

B. Report any defective tools, machines, or other equipment to the instructor.

C. Report all accidents to the instructor regardless of nature or severity.

D. Keep the laboratory floor and work area clear of scraps and litter.

E. Clean up any spilled liquids immediately.

F. Properly dispose of combustible materials or store in approved containers.

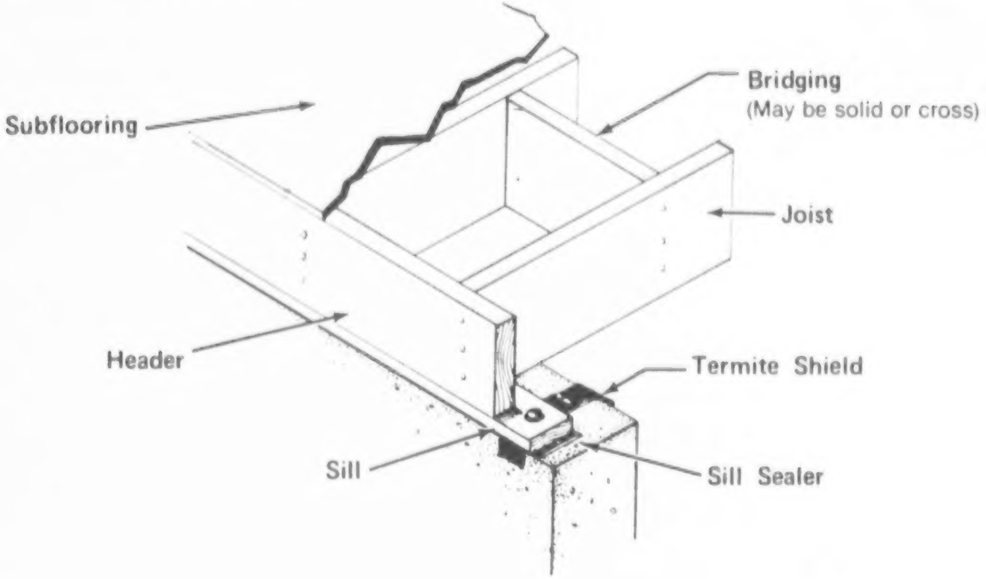
G. Keep aisles, traffic areas, and exits clear.

H. Keep materials, supplies, and tools properly stacked or stored.

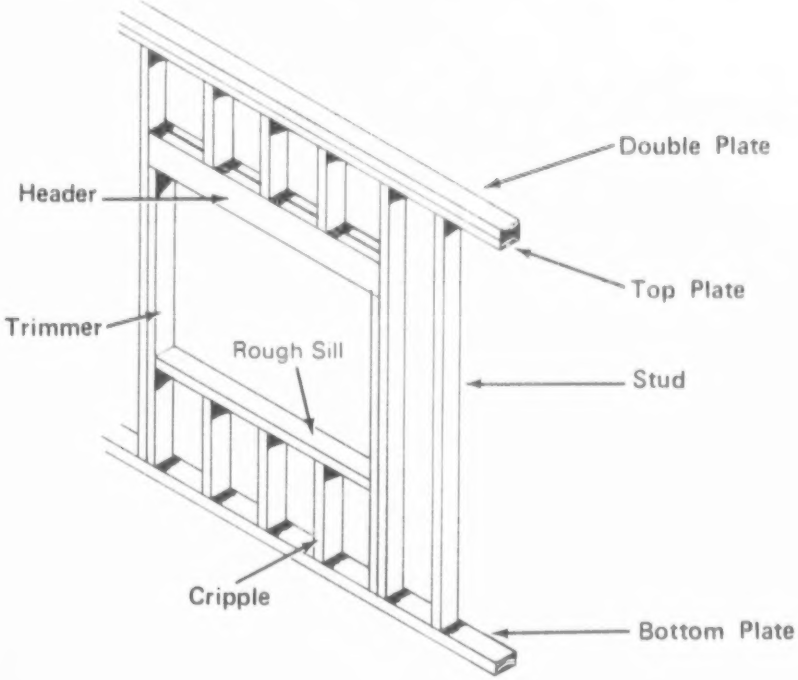
I. Use equipment and tools only after receiving permission from instructor.

INFORMATION SHEET

XIII. Parts of a floor frame

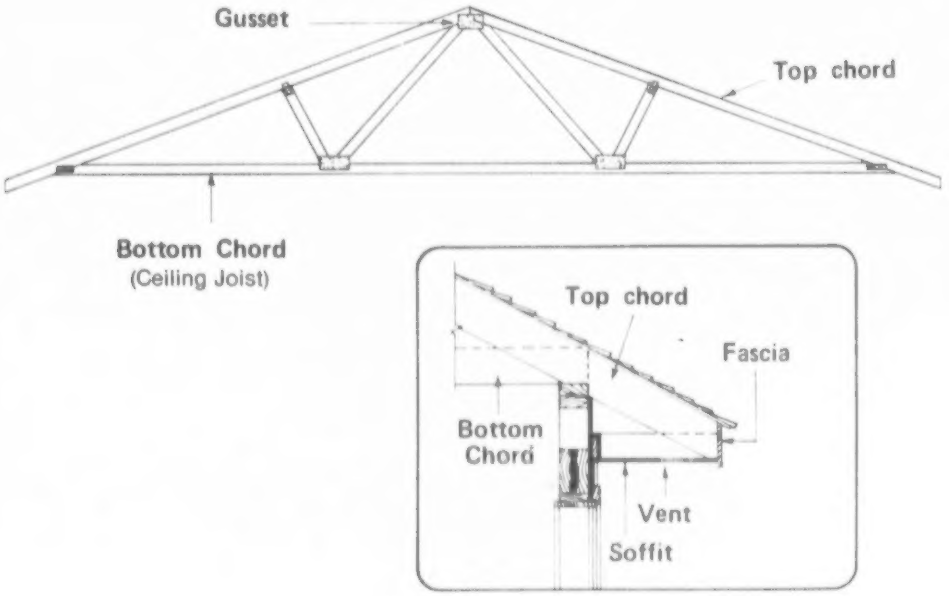

Subflooring
Bridging
(May be solid or cross)
Joist
Header
Termite Shield
Sill
Sill Sealer

XIV. Parts of a wall frame

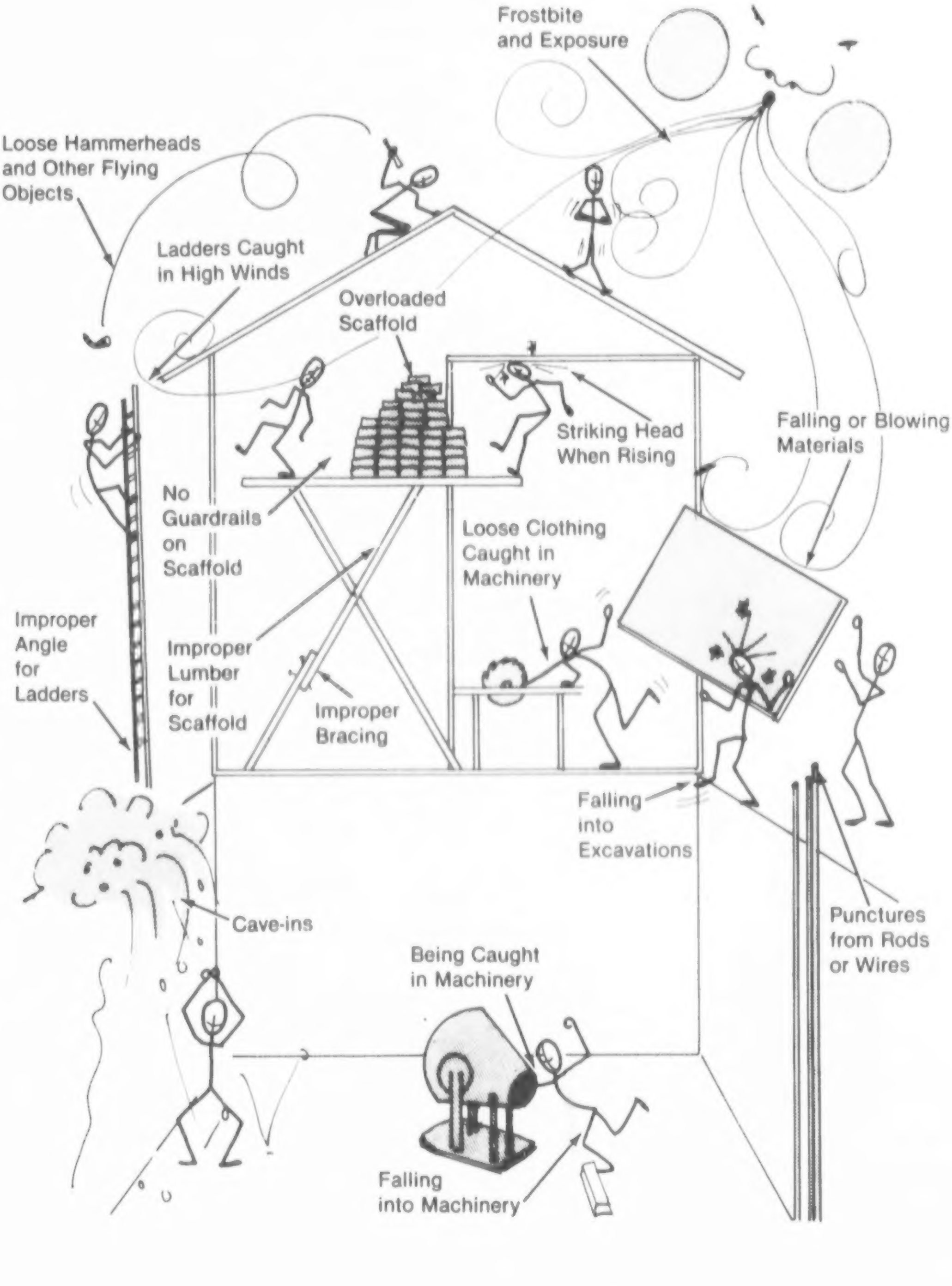

Double Plate
Header
Top Plate
Trimmer
Rough Sill
Stud
Cripple
Bottom Plate

INFORMATION SHEET

XV. Parts of a roof frame (truss)

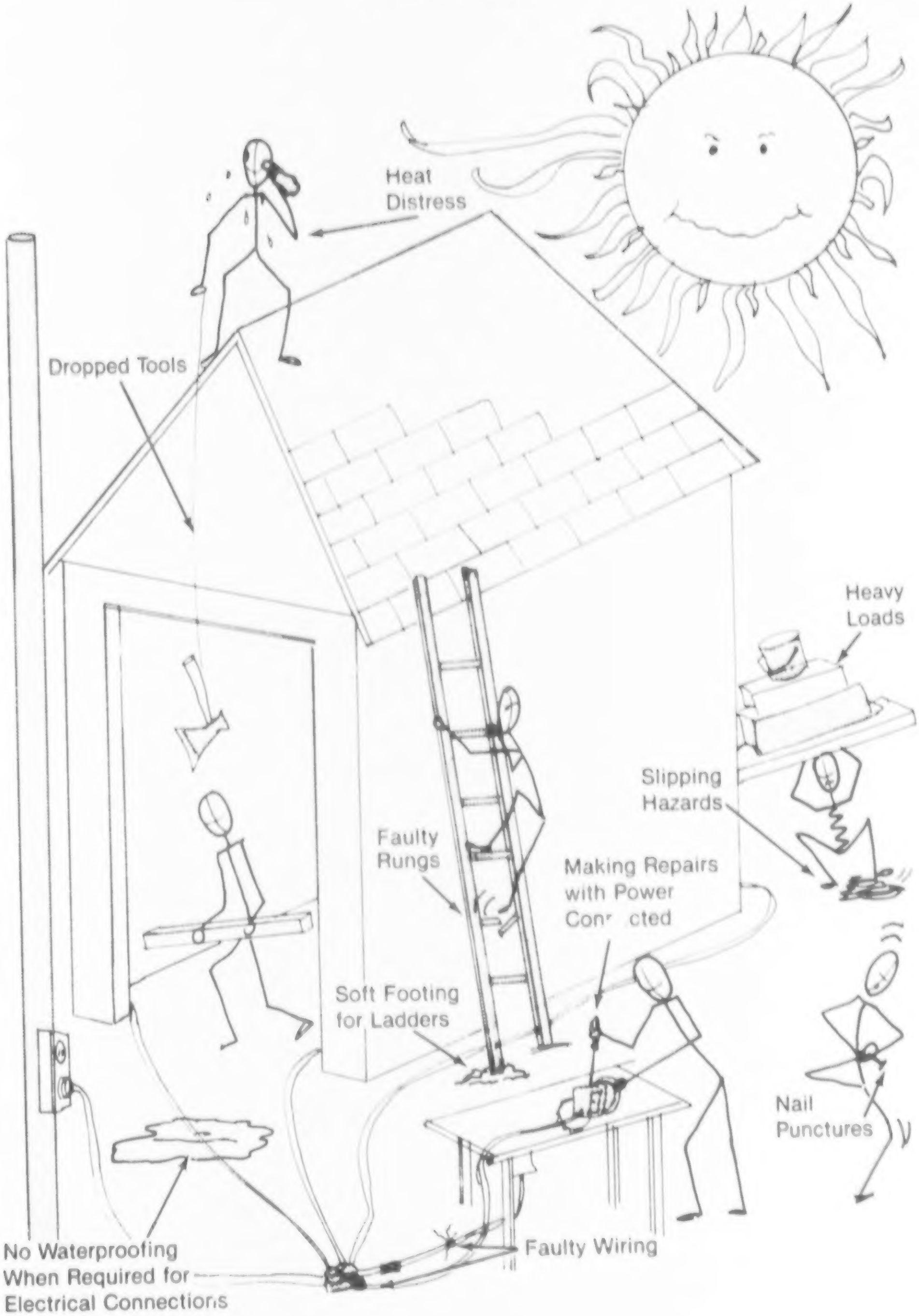

Gusset
Top chord
Bottom Chord
(Ceiling Joist)
Top chord
Fascia
Bottom Chord
Vent
Soffit

Safety Hazards


Frostbite and Exposure
Loose Hammerheads and Other Flying Objects
Ladders Caught in High Winds
Overloaded Scaffold
Striking Head When Rising
Falling or Blowing Materials
No Guardrails on Scaffold
Loose Clothing Caught in Machinery
Improper Angle for Ladders
Improper Lumber for Scaffold
Improper Bracing
Falling into Excavations
Cave-ins
Punctures from Rods or Wires
Being Caught in Machinery
Falling into Machinery

Safety Hazards

(Continued)


Heat
Distress
Dropped Tools
Heavy
Loads
Slipping
Hazards
Faulty
Rungs
Making Repairs
with Power
Connected
Soft Footing
for Ladders
Nail
Punctures
Faulty Wiring
No Waterproofing
When Required for
Electrical Connections

BUILDING THE STRUCTURE
UNIT III-C

JOB SHEET #1 — PREPARE A SITE

A. Tools and equipment

1. Shovel
2. Hoe
3. Rake
4. Handsaw
5. Wheelbarrow
6. Other tools

B. Procedure

(NOTE: Preparation to build should be in accordance with project selected in Unit II-C, Assignment Sheet #3, "Design a Project." If actual site preparation is not required, an alternate method shown in Job Sheet #2 may be used.)

1. Dig up or cut down all obstacles.
2. Place obstacles in wheelbarrow.
3. Remove obstacles from site.
4. Clean and store tools as directed by instructor.

BUILDING THE STRUCTURE
UNIT III-C

JOB SHEET #2 — PREPARE A SITE: ALTERNATE METHOD

A. Tools and materials

1. Claw hammer
2. Nails
3. ½" × 4' × 4' plywood
4. 4 - ¾" × 3" × 3' 11¼"
5. 4 - 5 gallon buckets of sand
6. Obstacles
    a. Trees — Green sponge on stick
    b. Buildings — Cardboard boxes
    c. Boulders — Rocks
    d. Ponds and creeks — Blue construction paper
    e. Fences — Sticks and string
    f. Underbrush — Twigs
    g. Other obstacles as desired

B. Procedure

1. Construct site box.
2. Arrange site in box.
3. Construct obstacles as indicated above.
4. Identify obstacles to be removed.
5. Determine the most efficient methods to remove the obstacles.
6. Remove obstacles from the site as directed for each group situation.
7. Clean and store equipment and tools as directed by instructor.

BUILDING THE STRUCTURE
UNIT III-C

JOB SHEET #3 — CONSTRUCT FORMS FOR CONCRETE

(NOTE: Forms should be constructed to coordinate with project selected in Unit II-C. If not required, follow outline for Procedure B or C.

A. Tools and materials

1. Needed for all procedures
    a. Handsaw
    b. Claw hammer
    c. Level
    d. Steel square
    e. Sledge hammer
    f. 1 - 2" × 4" × 10' screeding board
    g. Duplex nails
    h. Strips of sheet metal
    i. Crude oil
2. Additional materials needed for Procedure B
    a. 2 - 1" × 4" × 6' #2 pine
    b. 2 - 1" × 4" × 11' #2 pine
    c. Sand
    d. Wire mesh - 6' × 11'
3. Additional tools and materials needed for Procedure C
    a. Rubber cement
    b. 3 styrofoam blocks $1\frac{5}{8}$" × $2\frac{1}{2}$" × $3\frac{5}{8}$"
    c. 2 sets butt hinges $1\frac{1}{2}$" × $\frac{7}{8}$"
    d. Large trowel
    e. Finishing trowel
    f. 1 - 2" × 4" × 38" (approx. length) #2 pine
    g. 1 - 2" × 4" × 30" (approx. length) #2 pine

JOB SHEET #3

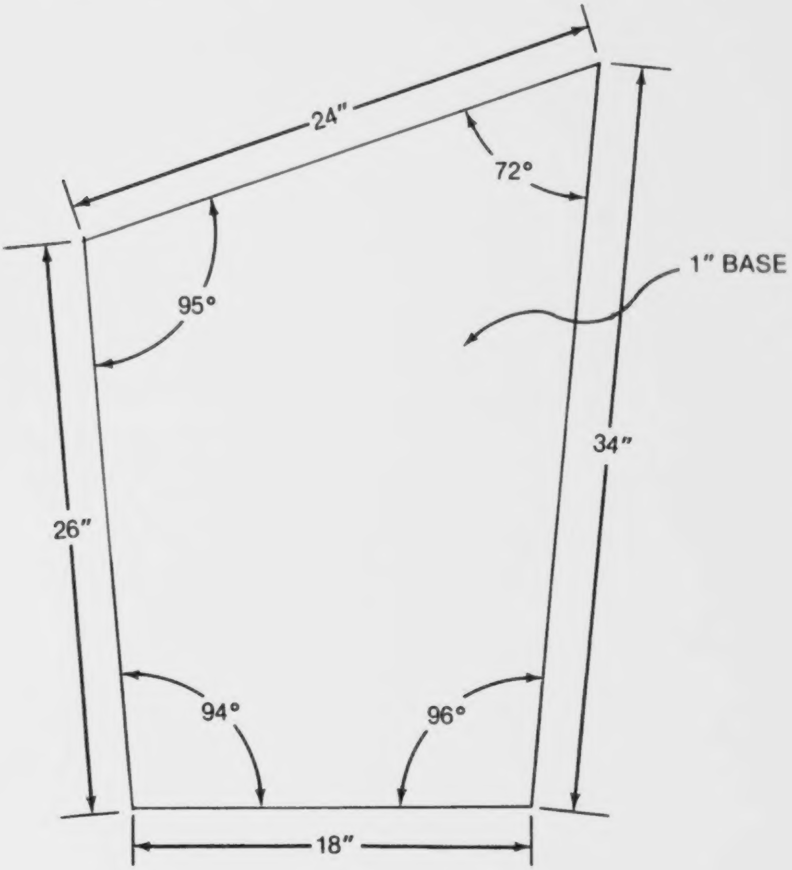
h. 1 - 2″ × 4″ × 22″ (approx. length) #2 pine

i. 1 - 2″ × 4″ × 28″ (approx. length) #2 pine

(NOTE: Items f.-i. will be used outside the frame. The ends need to be cut at right angles to fit outside of base.)

j. 1 - 1″ base cut as shown below (Figure 1)

FIGURE 1


24″
72°
95°
1″ BASE
34″
26″
94°
96°
18″

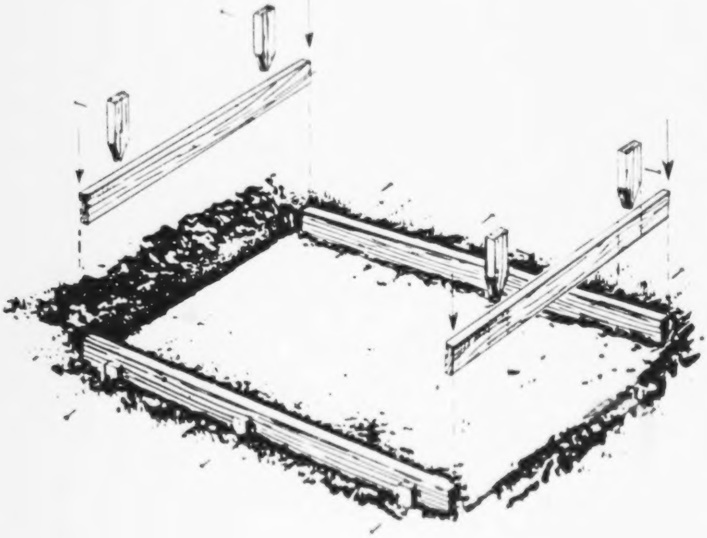
JOB SHEET #3

(NOTE: Ask your instructor if you should complete Procedure B or C.)

B. Procedure for sidewalk form

1. Level ground where walk is going to be placed.
2. Lay out forms.
3. Obtain stakes from instructor.
4. Set one side and drive stakes to hold in place according to design of walk. (Figure 2)

FIGURE 2



5. Set second side same as first side.
6. Place end boards and drive stakes to hold in place.

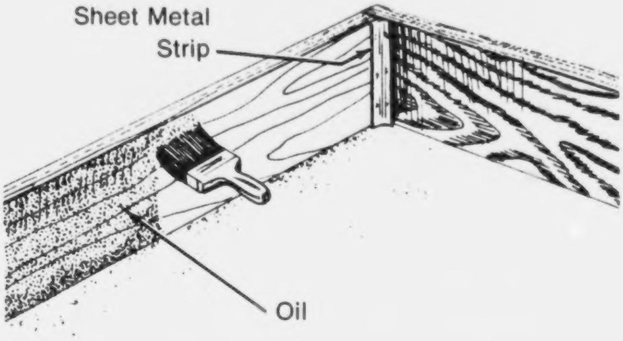
(NOTE: Stake should be below the top edge of the form.)

JOB SHEET #3

7. Using a duplex nail, nail the stake to the form side.

   (NOTE: One nail should be in each stake board. You may be instructed to round off the sharp corners with strips of sheet metal. You may also paint the inside of the forms with crude oil or crankcase oil.)

   FIGURE 3

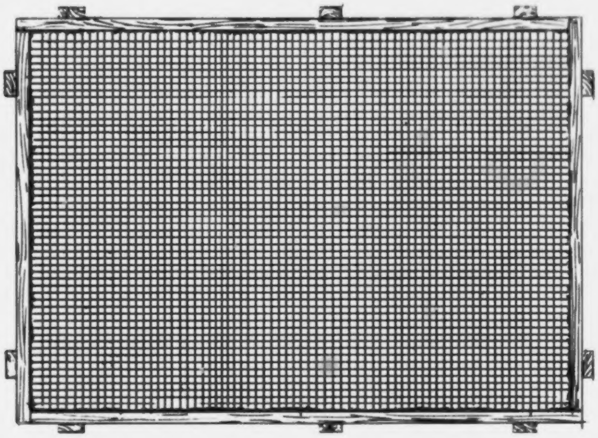


8. Place two inches of sand inside form and level.

9. Cut reinforcement wire to desired length and width; place in form. (Figure 4)

   (NOTE: Wire mesh should be spaced in such a way that it will be in the center of the concrete.)

   FIGURE 4



JOB SHEET #3

10. Recheck forms following design.

11. Have instructor inspect form.

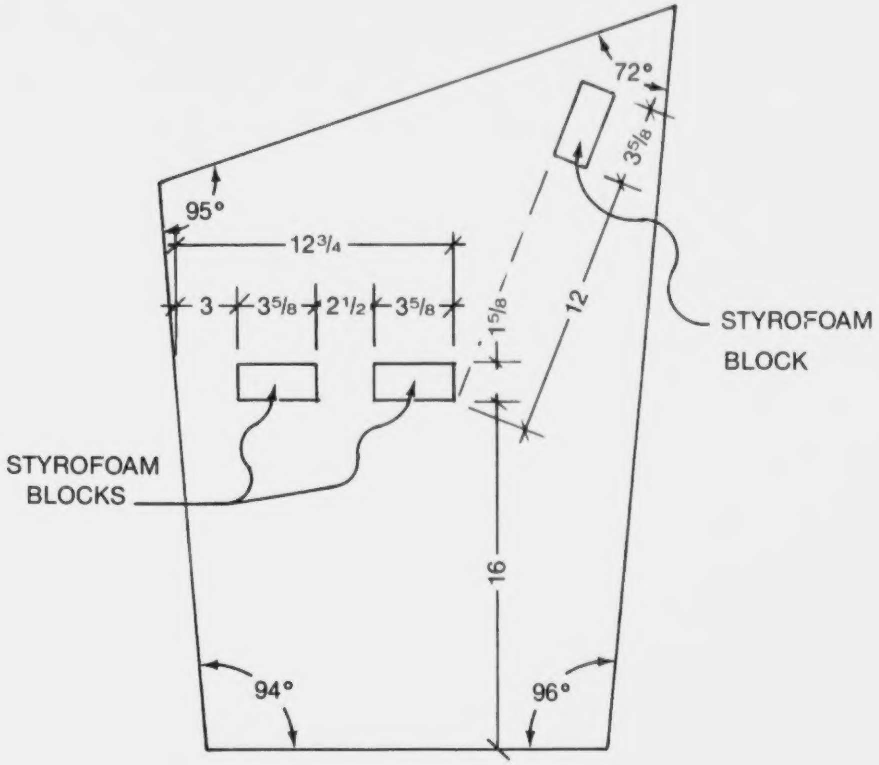
12. Clean and store tools and equipment as directed by the instructor.

C. Procedure for park bench

(NOTE: This procedure will produce only one end of the bench. Repeat procedure for a complete set.)

1. Glue styrofoam blocks to base with rubber cement as shown.

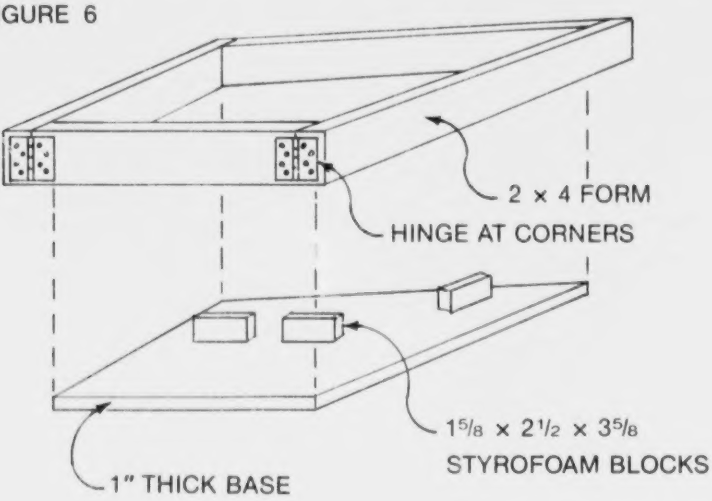
FIGURE 5


72°
3 5/8
95°
12 3/4
3
3 5/8
2 1/2
3 5/8
1 5/8
12
STYROFOAM
BLOCK
STYROFOAM
BLOCKS
16
94°
96°

JOB SHEET #3

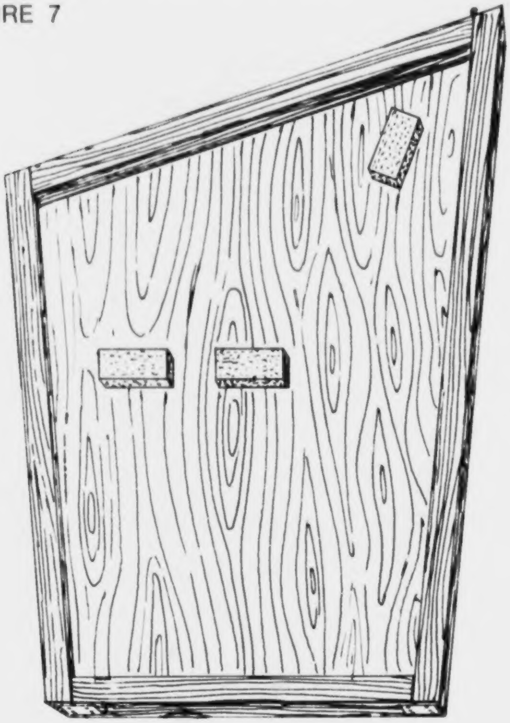
2. Place 2" × 4" form around base with hinges at corners as shown.

FIGURE 6


2 × 4 FORM
HINGE AT CORNERS
1⅝ × 2½ × 3⅝
STYROFOAM BLOCKS
1" THICK BASE

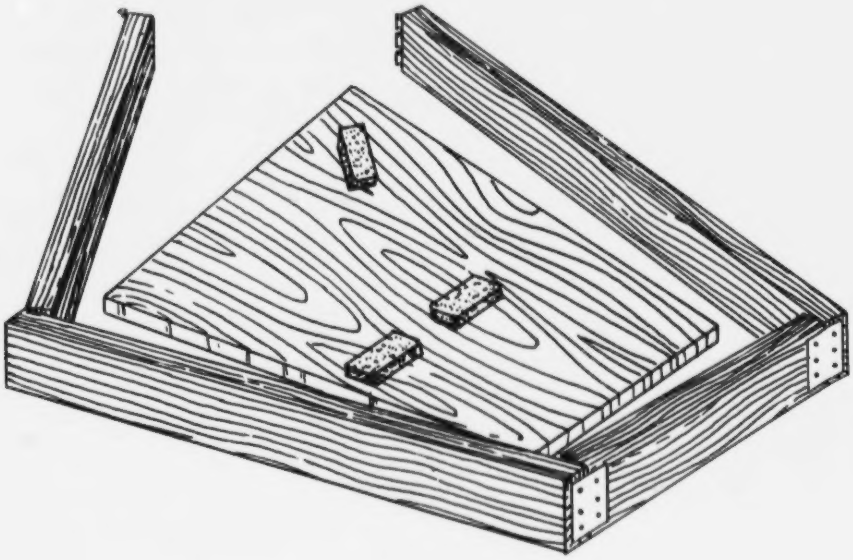
   a. Completed form should be as shown.

   FIGURE 7



JOB SHEET #3

b. Form should be removable from base as shown.



BUILDING THE STRUCTURE
UNIT III-C

JOB SHEET #4 — PERFORM A SLUMP TEST

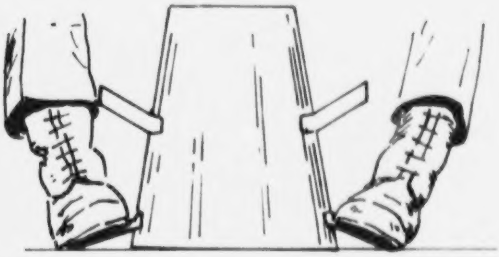
A. Tools and materials

1. Wheelbarrow
2. Slump cone mold
3. Bullet-nosed steel rod (smooth) $^{5}/_{8}$" by 24"
4. Scoop or trowel
5. Rule
6. Concrete
7. Water in container

B. Procedure

1. Collect concrete in wheelbarrow.
2. Dampen slump cone mold with water.
3. Place slump cone mold on firm, level, clean, nonabsorbent surface.
4. Stand on the foot pieces of cone mold to hold it firmly in place. (Figure 1)

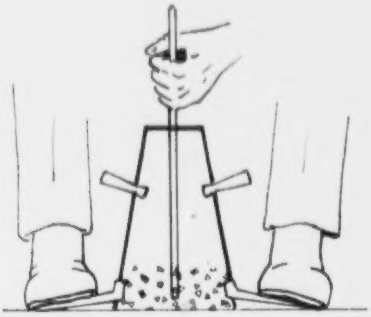
FIGURE 1



JOB SHEET #4

5. Fill one third of cone mold with concrete. (Figure 2)

FIGURE 2

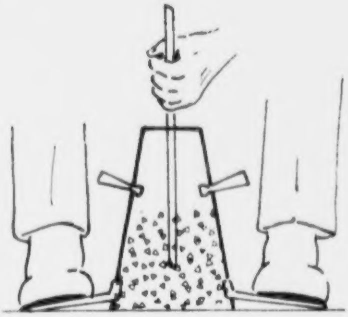


6. Rod with up and down motion twenty-five times using steel rod.

(NOTE: Always distribute rodding strokes evenly by starting at outer edge and moving in a spiral toward center.)

7. Fill two thirds of cone mold with concrete. (Figure 3)

FIGURE 3

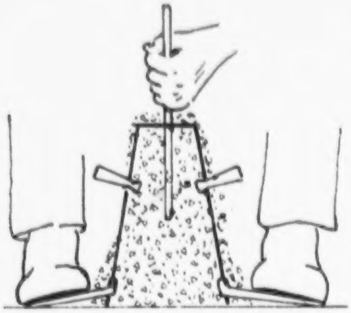


8. Rod twenty-five times barely penetrating into first layer.

JOB SHEET #4

9. Fill cone mold to overflowing with concrete. (Figure 4)

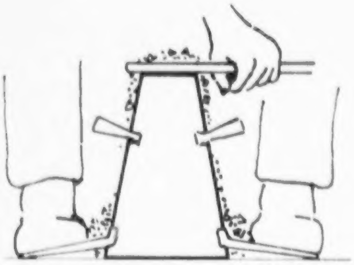
FIGURE 4



10. Again rod twenty-five times taking same precautions about depth and distribution of strokes.

11. Level top of cone with steel rod so that cone mold is level full. (Figure 5)

FIGURE 5



12. Clean excess concrete away from base of cone mold.

13. Immediately raise cone mold taking only five to ten seconds to perform this operation.

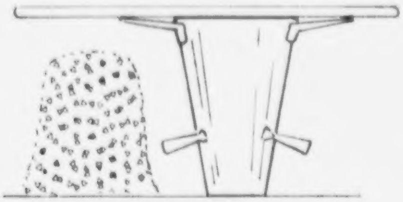
    (CAUTION: Remove cone mold with a steady upward lift. Do not shake mold in any way or disturb the sample.)

14. Place cone mold next to sample upside down, taking care not to disturb sample.

JOB SHEET #4

15. Place steel rod horizontally across mold so that it extends over the sample. (Figure 6)

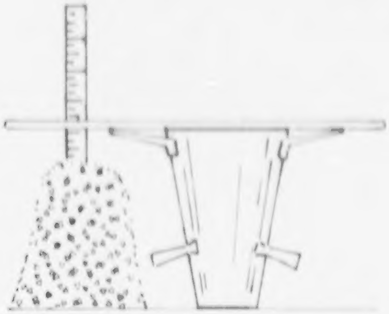
FIGURE 6



16. Measure distance from bottom of steel rod to the point of the original center of sample. (Figure 7)

(NOTE: This measurement, to the nearest ¼ inch, is the slump of the concrete.)

FIGURE 7



17. Put away equipment and materials and clean work area as directed by instructor.

BUILDING THE STRUCTURE
UNIT III-C

JOB SHEET #5 — MIX AND FINISH CONCRETE

A. Tools and materials for procedure B or C

(NOTE: Plan to continue with the same procedure (B or C) used in Job Sheet #3.)

1. For mixing concrete
   a. Shovel
   b. Hoe and trowel for mixing
   c. Container, suitable for mixing concrete
   d. Ingredients for concrete
   e. Water source
2. For finishing concrete
   a. Strike-off board
   b. Jitterbug or hand wood float
   c. Bull float
   d. Large hand trowel
   e. Finishing trowel
   f. Edger
   g. Plastic bucket
   h. Concrete — 1 yard (or amount indicated by instructor)

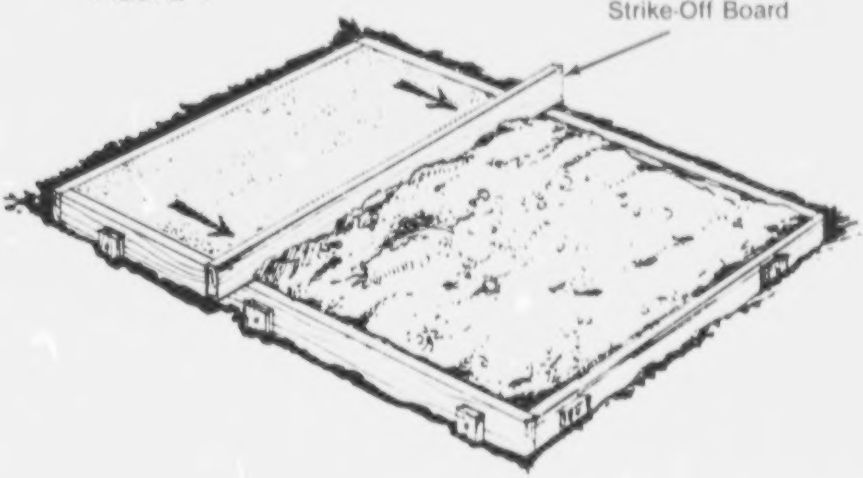
B. Procedure for sidewalk

1. Mix concrete according to instructor's directions.
2. Place concrete in forms.

JOB SHEET #5

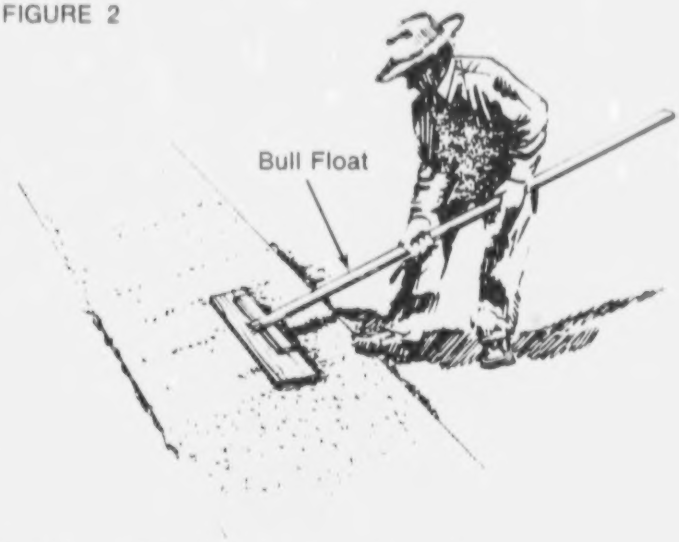
3. Screed concrete using a strike-off board. (Figure 1)

FIGURE 1



4. Jitterbug the concrete lightly to tamp the aggregate.
5. Float the sidewalk surface. (Figure 2)

FIGURE 2



6. Finish troweling the surface until smooth.
7. Wash all tools and equipment in water as directed by the instructor.

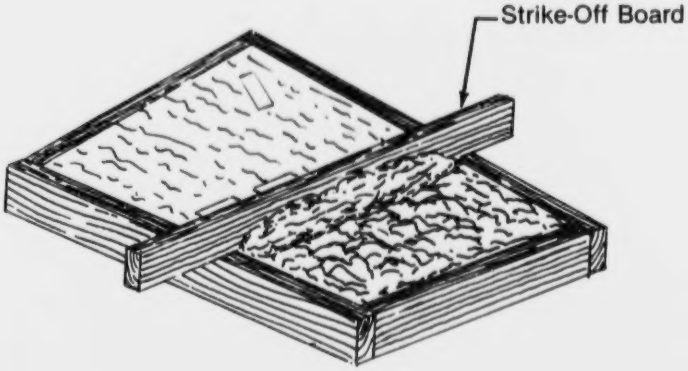
(NOTE: The forms will need to be cleaned before they can be used again.)

JOB SHEET #5

C. Procedure for park bench

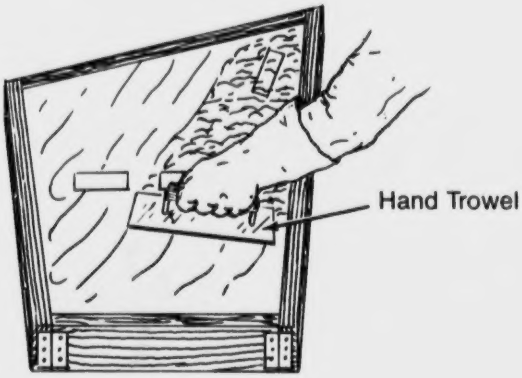
1. Mix concrete according to instructor's direction.
2. Place concrete in form.
3. Screed concrete using strike-off board. (Figure 3)

FIGURE 3


Strike-Off Board

4. Finish surface using a large hand trowel. (Figure 4)

FIGURE 4

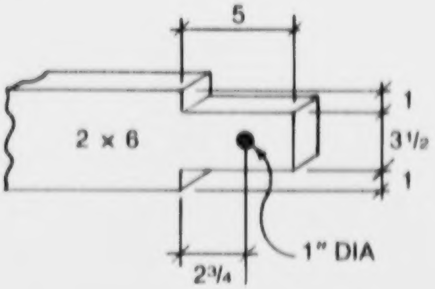

Hand Trowel

JOB SHEET #5

5. Finish troweling the surface until smooth.
6. Wash all tools and equipment in water as directed by the instructor.

   (NOTE: The forms will need to be cleaned before they can be used again.)
7. Follow instructor's directions and finish bench as follows:
   a. Complete two concrete end pieces.
   b. Allow concrete to cure as directed.
   c. Prepare 3 - 2" × 6" × 5' pine as shown in Figure 5.

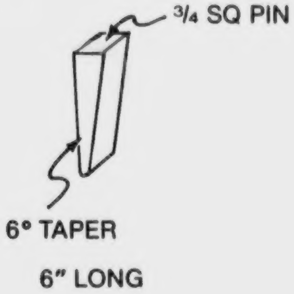
      FIGURE 5



   d. Produce 6 wedge-shaped pins according to dimensions in Figure 6.

      (NOTE: Scrap pieces of lumber may be used for these.)

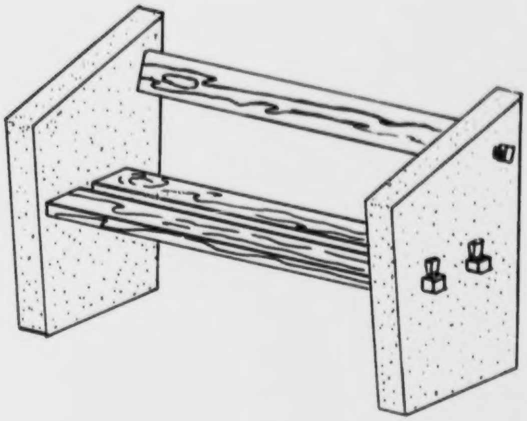
      FIGURE 6



JOB SHEET #5

e. Assemble bench as shown in Figure 7

FIGURE 7



BUILDING THE STRUCTURE
UNIT III-C

JOB SHEET #6 — BUILD A STRUCTURE

(NOTE: The building procedure should be in accordance with project selected in Unit II-C, Assignment Sheet #3.)

A. Tools and materials — As required for project

B. Procedure

1. Frame project according to plan.

   (NOTE: Project should include floor frame, wall frame, and roof frame.)

   (CAUTION: Always use safety equipment such as safety glasses, safety helmet, and machine guards.)

2. Plan for and install roughed in utility systems as required.

   (NOTE: These systems will be completed in detail in Unit IV-C.)

3. Finish outside walls and roof as required.

4. Clean and store tools and materials after each laboratory session as directed by instructor.

BUILDING THE STRUCTURE
UNIT III-C

PRACTICAL TEST
JOB SHEETS #1-#2 — PREPARE A SITE

STUDENT'S NAME ________________________________ DATE ____________

EVALUATOR'S NAME ________________________________ ATTEMPT NO. ______

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the material and try again.)

The student:	YES	NO
1. Checked out proper tools.	____	____
2. Followed instructor's directions.	____	____
3. Used tools safely.	____	____
4. Worked well as a team member.	____	____
5. Used most expedient method to remove brush, rocks and other obstacles.	____	____
6. Disposed of obstacles as instructed.	____	____
7. Checked in/put away tools and materials.	____	____
8. Cleaned the work area.	____	____
9. Used proper tools correctly.	____	____
10. Performed steps in a timely manner. (___hrs.___min.___sec.)	____	____
11. Practiced safety rules throughout procedure.	____	____
12. Provided satisfactory responses to questions asked.	____	____

EVALUATOR'S COMMENTS: ____

____

PRACTICAL TEST

JOB SHEETS #1-#2

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

Site is ready for construction	4	3	2	1
Salvage shrubs or material was not damaged	4	3	2	1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled — Can perform job with no additional training.
3 — Moderately skilled — Has performed job during training program; limited additional training may be required.
2 — Limited skill — Has performed job during training program; additional training is required to develop skill.
1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR'S NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BUILDING THE STRUCTURE
UNIT III-C

PRACTICAL TEST
JOB SHEET #3 — CONSTRUCT FORMS FOR CONCRETE

STUDENT'S NAME ____________________________ DATE __________

EVALUATOR'S NAME ____________________________ ATTEMPT NO. ______

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the material and try again.)

The student:	YES	NO
1. Checked out proper tools.	____	____
2. Followed instructor's directions.	____	____
3. Used tools safely.	____	____
4. Worked well as a team member.	____	____
5. Checked in/put away tools and materials.	____	____
6. Cleaned the work area.	____	____
7. Used proper tools correctly.	____	____
8. Performed steps in a timely manner. (___hrs.___min.___sec.)	____	____
9. Practiced safety rules throughout procedure.	____	____
10. Provided satisfactory responses to questions asked.	____	____

EVALUATOR'S COMMENTS: ____

____

PRACTICAL TEST

JOB SHEET #3

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Forms were prepared correctly	4	3	2	1
Forms were well constructed	4	3	2	1

EVALUATOR'S COMMENTS: ____________________

____

PERFORMANCE EVALUATION KEY
4 — Skilled — Can perform job with no additional training. 3 — Moderately skilled — Has performed job during training program; limited additional training may be required. 2 — Limited skill — Has performed job during training program; additional training is required to develop skill. 1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR'S NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BUILDING THE STRUCTURE
UNIT III-C

PRACTICAL TEST
JOB SHEET #5 — MIX AND FINISH CONCRETE

STUDENT'S NAME ______________________________ DATE __________

EVALUATOR'S NAME ______________________________ ATTEMPT NO. ______

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the material and try again.)

The student:	YES	NO
1. Checked out proper tools.	____	____
2. Performed assigned task or duty.	____	____
3. Worked well as a team member.	____	____
4. Concrete was mixed as directed.	____	____
5. Followed instructions for finishing concrete.	____	____
6. Checked in/put away tools and materials.	____	____
7. Cleaned the work area.	____	____
8. Used proper tools correctly.	____	____
9. Performed steps in a timely manner. (___hrs.___min.___sec.)	____	____
10. Practiced safety rules throughout procedure.	____	____
11. Provided satisfactory responses to questions asked.	____	____

EVALUATOR'S COMMENTS: ____

____

PRACTICAL TEST

JOB SHEET #5

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Concrete surface was smooth when finished	4	3	2	1
Edges were finished as directed	4	3	2	1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled — Can perform job with no additional training.
3 — Moderately skilled — Has performed job during training program; limited additional training may be required.
2 — Limited skill — Has performed job during training program; additional training is required to develop skill.
1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR'S NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BUILDING THE STRUCTURE
UNIT III-C

PRACTICAL TEST
JOB SHEET #6 — BUILD A STRUCTURE

STUDENT'S NAME ______________________________ DATE ____________

EVALUATOR'S NAME ______________________________ ATTEMPT NO. ______

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the material and try again.)

The student:	YES	NO
1. Checked out proper tools.	____	____
2. Followed instructor's directions.	____	____
3. Worked well as a team member.	____	____
4. Followed plans well.	____	____
5. Performed assigned task in an orderly manner.	____	____
6. Checked in/put away tools and materials.	____	____
7. Cleaned the work area.	____	____
8. Used proper tools correctly.	____	____
9. Performed steps in a timely manner. (___hrs.___min.___sec.)	____	____
10. Practiced safety rules throughout procedure.	____	____
11. Provided satisfactory responses to questions asked.	____	____

EVALUATOR'S COMMENTS: ______________________________

____

PRACTICAL TEST

JOB SHEET #6

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:	4	3	2	1
Project met plan specifications				

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled — Can perform job with no additional training.
3 — Moderately skilled — Has performed job during training program; limited additional training may be required.
2 — Limited skill — Has performed job during training program; additional training is required to develop skill.
1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR'S NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

BUILDING THE STRUCTURE
UNIT III-C

NAME ____________________________ SCORE ______________________

TEST

1. Match the terms on the right with their correct definitions.

_____a. To determine the form and position of a tract of land

_____b. Laws set by governments (usually city) to control land use

_____c. Permission to use the land

_____d. Government regulations (national, state, and local) that determine how a building is to be built; these regulations are primarily to protect the public's health and safety

1. Building codes
2. Survey
3. Bill of sale
4. Zoning ordinance
5. Building permit
6. Warranty deed

2. Select from the following list the factors to be considered in clearing a site for construction by placing an "X" in the appropriate blanks.

_____a. Time of year

_____b. Size of building

_____c. Natural obstacles

_____d. Cost of building

_____e. Position of the building on a site

3. List three methods used to clear a site.

a. ____

b. ____

c. ____

4. Select the correct general safety rules for using earthmoving equipment by circling the correct letters.

a. To save wear on engine, leave equipment with the engine running when taking a break.

b. Safety helmets and safety glasses must be worn at all times.

c. The engine should be turned off before making repairs on equipment.

d. The driver may have riders on the equipment if approved by the foreman.

e. Before starting equipment, make sure all other workers are away from the machine.

TEST

5. Match the terms on the right with their correct definitions.

_____a. A mixture of cement, sand, gravel, and water

_____b. A binding ingredient for mortar and cement

_____c. Materials such as sand and gravel used to give bulk and body to concrete

_____d. Mixture that when ordered is ready for pouring

_____e. A joint in a masonry or concrete unit used to provide for expansion due to temperature changes

_____f. A cut made at least ⅓ of the way in the slab to make a weakened plane in the concrete

_____g. Roll or sheet welded wire mesh used in flat concrete work such as floor slabs, pavements, and sidewalks

_____h. Steel bars of various sizes used to reinforce load-bearing concrete containing curves or bends

_____i. Bolts embedded in concrete used to hold structural members in place

_____j. A double-headed fastener that can be easily removed

_____k. Concrete containing steel reinforcement

1. Anchor bolts
2. Control joint
3. Concrete
4. Eye bolts
5. Duplex nail
6. Cement
7. Metal plate
8. Rebar
9. Butt joint
10. Aggregate
11. Wire mesh reinforcement
12. Sand
13. Ready-mixed concrete
14. Gravel
15. Expansion joint
16. Reinforced concrete

6. Match concrete ingredients on the right with their ratios used in mixing.

_____a. Four parts

_____b. One part

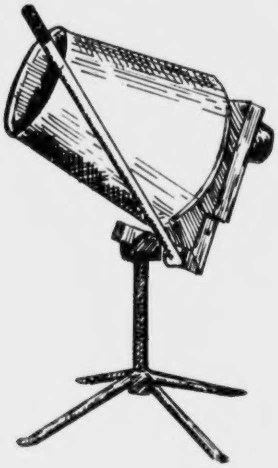
_____c. Three parts

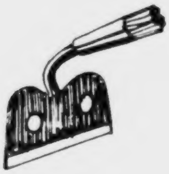
_____d. Amount varies

1. Cement
2. Water
3. Sand
4. Gravel

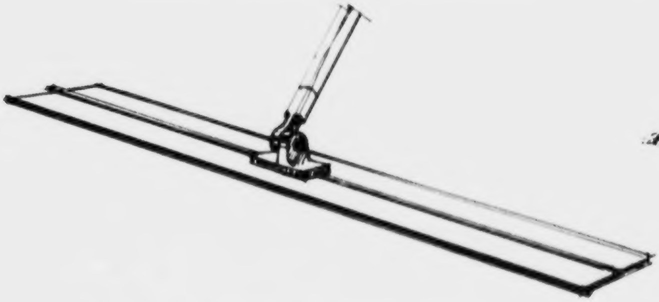
TEST

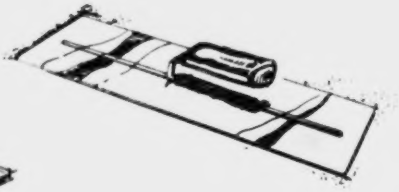
7. Identify tools and equipment used in concrete work.



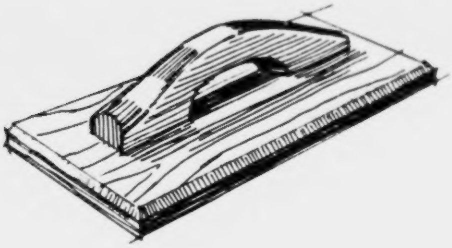


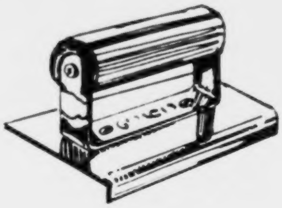
a. ______________________________ b. ______________________________





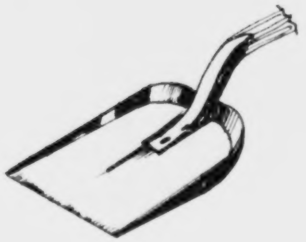
c. ______________________________ d. ______________________________

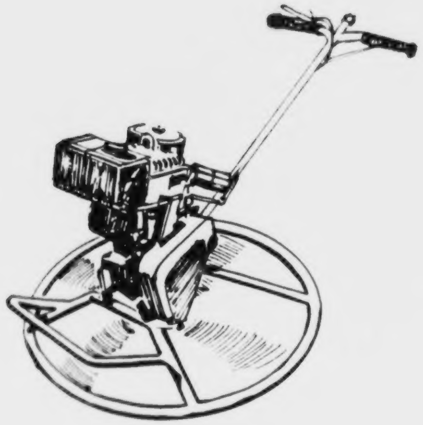




e. ______________________________ f. ______________________________

TEST

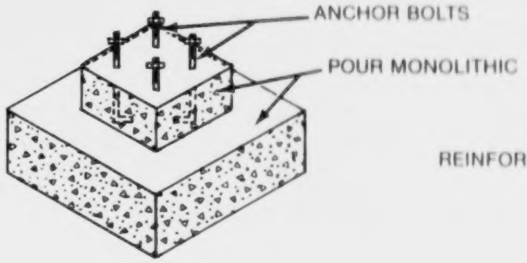


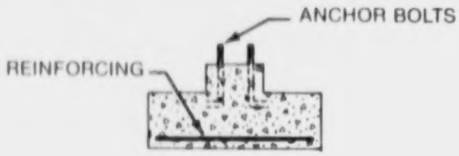


g. ____________________

h. ____________________

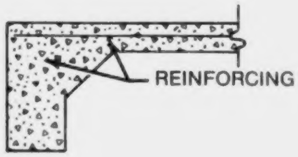
8. Identify the concrete footings and foundations shown.


ANCHOR BOLTS
POUR MONOLITHIC


ANCHOR BOLTS
REINFORCING

a. ____________________

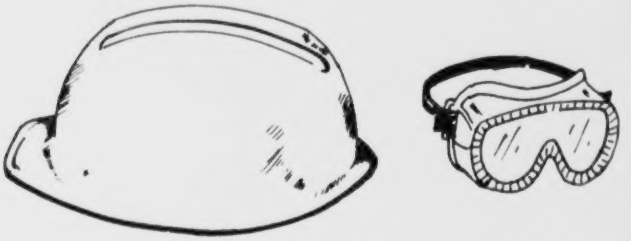
b. ____________________


REINFORCING

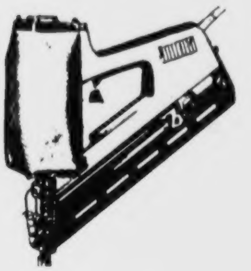
c. ____________________

TEST

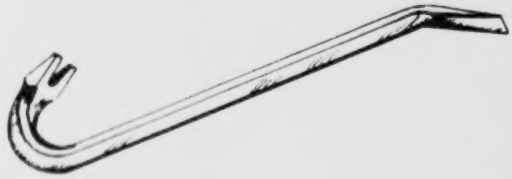
9. Identify tools and equipment used in general construction.



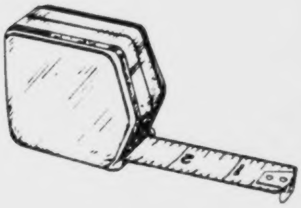
a. ______________________________



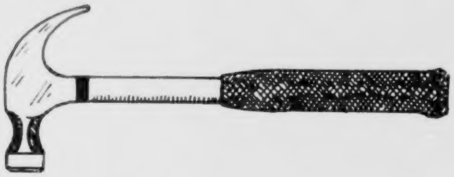
b. ______________________________



c. ______________________________

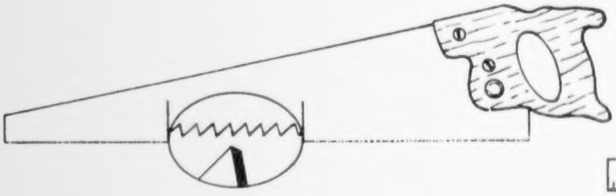


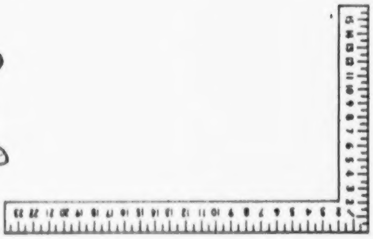
d. ______________________________



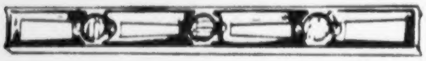
e. ______________________________

TEST





f. ______________________________ g. ______________________________



h. ______________________________

10. List three precautions to follow in the care of tools.

a. ______________________________

b. ______________________________

c. ______________________________

11. Select true statements concerning personal safety rules by placing an "X" in the blanks preceding the true statements.

_____a. Wear safety glasses sometimes.

_____b. Conduct yourself in a manner conducive to safe laboratory practices.

_____c. Remove rings and other jewelry when working in the laboratory.

_____d. Keep hands clean.

_____e. Wear any type of clothing you wish when in the laboratory.

_____f. Wear long chains or scarves as you wish.

TEST

12. Select true statements concerning correct rules for laboratory safety and maintenance by placing an "X" next to the true statements.

______a. Toss defective tools in trash can immediately.

______b. Keep aisles, traffic areas, and exits clear.

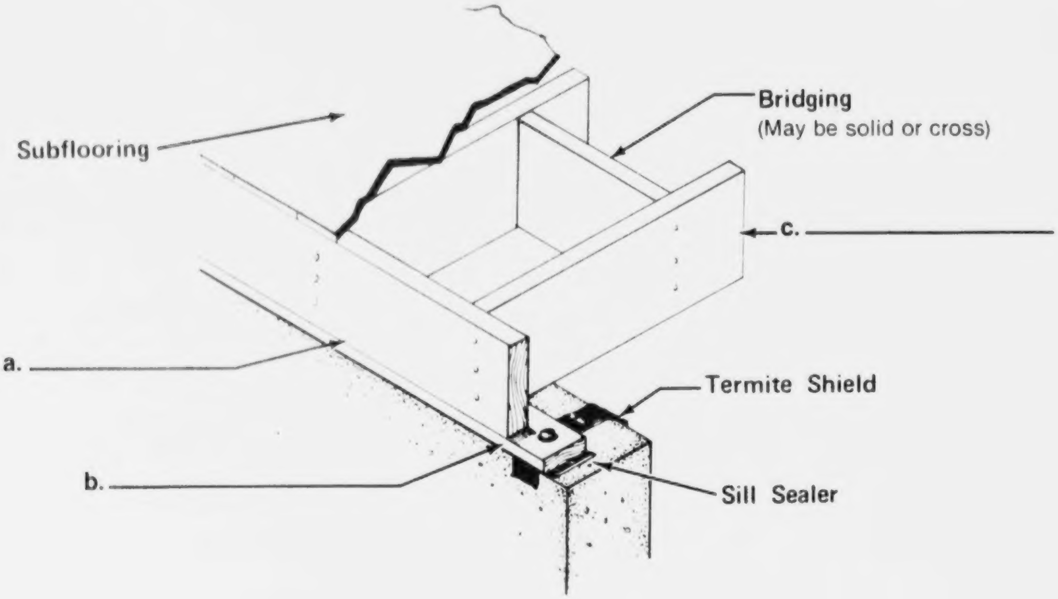
______c. Report all accidents to the instructor regardless of severity.

______d. Use tools only if they are dull.

______e. Ignore spills on the floor.

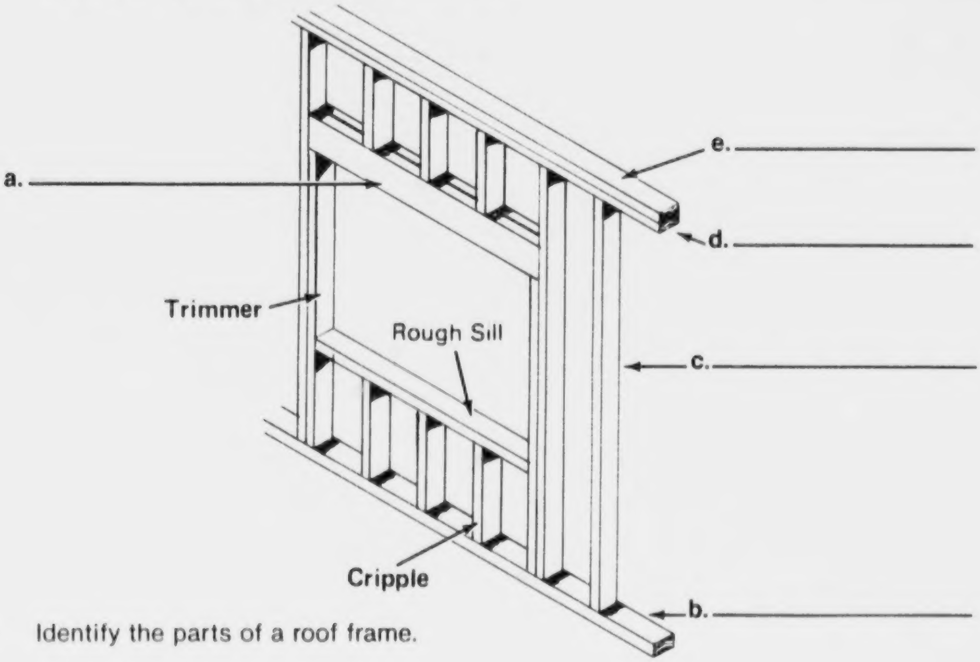
______f. Keep materials, supplies and tools properly stacked.

13. Identify the missing parts of a floor frame.

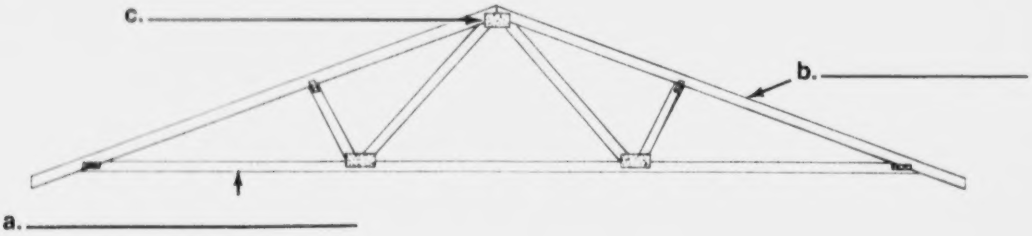

Subflooring
Bridging
(May be solid or cross)
c. ______________
a. ______________
Termite Shield
b. ______________
Sill Sealer

TEST

14. Identify the missing parts of a wall frame.



15. Identify the parts of a roof frame.



(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

16. Demonstrate the ability to:
    a. Prepare a site. (Job Sheet #1 or #2)
    b. Construct forms for cement. (Job Sheet #3)
    c. Perform a slump test. (Job Sheet #4)
    d. Mix and finish concrete. (Job Sheet #5)
    e. Build a structure. (Job Sheet #6)

BUILDING A STRUCTURE
UNIT III-C

ANSWERS TO TEST

1. a. 2
   b. 4
   c. 5
   d. 1

2. a, b, c, e

3. Answer should include any three of the following:
   a. Earthmoving
   b. Cutting
   c. Demolition
   d. Salvage
   e. Disposal

4. b, c, e

5. a. 3
   b. 6
   c. 10
   d. 13
   e. 15
   f. 2
   g. 11
   h. 8
   i. 1
   j. 5
   k. 16

6. a. 4
   b. 1
   c. 3
   d. 2

7. a. Portable mixer
   b. Hoe
   c. Bull float
   d. Trowel (steel)
   e. Float (wooden hand)
   f. Edger
   g. Shovel
   h. Power trowel

8. a. Pier
   b. Spread footing
   c. Slab poured monolithic

ANSWERS TO TEST

9. a. Safety equipment (helmet and goggles)
   b. Power stapler
   c. Wrecking bar
   d. Measuring device (steel tape)
   e. Claw hammer
   f. Hand saw
   g. Square (steel framing)
   h. Carpenter's level

10. Answer should include three of the following:
    a. Do not drop tools.
    b. Keep tools clean.
    c. Make sure tools are sharp.
    d. Return tools to cabinet after use.
    e. Keep tools dry and oiled.
    f. Use tools only for the purpose intended.

11. a. O
    b. X
    c. X
    d. X
    e. O
    f. O

12. b, c, f

13. a. Joist
    b. Sill
    c. Header

14. a. Header
    b. Bottom plate
    c. Stud
    d. Top plate
    e. Double plate

15. a. Bottom chord
    b. Top chord
    c. Gusset

16. Performance skills evaluated to the satisfaction of the instructor

FINISHING THE STRUCTURE
UNIT IV-C

UNIT OBJECTIVE

After completion of this unit, the student should be able to participate as a team member in the finishing of a project. Competencies will be demonstrated by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to finishing the project with their correct definitions.
2. Name types of energy used in construction.
3. Discuss climate control processes.
4. Distinguish between types of solar systems.
5. Select the purposes of plumbing systems.
6. State the two major uses of electrical systems.
7. List three phases of finishing a project.
8. Demonstrate the ability to:
    a. Build and operate a passive solar collector. (Job Sheet #1)
    b. Finish the structure. (Job Sheet #2)

FINISHING THE STRUCTURE
UNIT IV-C

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information sheet.

F. Discuss information sheet.

G. Provide students with job sheets.

H. Discuss and demonstrate the procedures outlined in the job sheets.

I. Integrate the following activities throughout the teaching of this unit:

   1. Use computer software program for design problems if possible.

   2. Discuss careers related to the areas covered in this unit.

   3. Discuss solar energy as a reenergizing energy source and discuss how it affects the construction industry.

   4. Discuss the importance of insulation in construction to prevent heat loss. Use Handouts #1 and #2 to discuss temperature differences that affect construction design and R-values.

   5. Discuss the use of advanced technology in the design and building of the "Smart House" research project. Contact the following for information:

      National Association of Home Builders Research Foundation
      P.O. Box 1627
      Rockville, MD 20850
      phone (301)762-4200

   6. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

I. Administer test.

J. Evaluate test.

K. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Lindbeck, John R., Irwin T. Lathrop, John L. Feirer. *General Industrial and Technology.* Peoria, IL: Bennett & McKnight Publishing Company, 1986.

B. Henak, Richard M. *Exploring Construction.* South Holland, IL: The Goodheart-Willcox Company, Inc., 1985.

C. Spence, William P. *Architecture.* Peoria, IL: Bennett and McKnight Publishing Company, 1985.

D. Fulkerson, Dan. *Residential Solar Systems.* Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc., 1982.

SUGGESTED SUPPLEMENTAL RESOURCES

Solar Energy: Hope for the Future, VHS Video Program #5-4539. Available from:

Vocational Media
Box 1050
Mt. Kisco, NY 10549
1-800-431-2266

FINISHING THE STRUCTURE
UNIT IV-C

INFORMATION SHEET

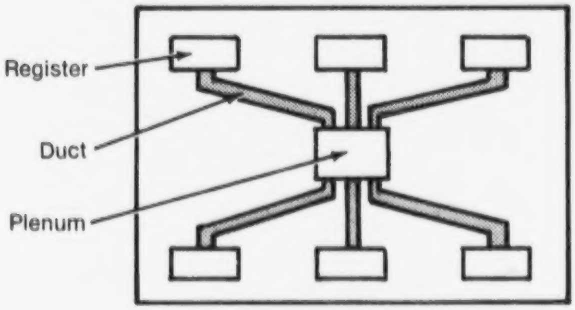
I. **Terms and definitions**

A. Heat pump — A device that can heat or cool a building by taking heat from one place to another

B. Ducts — Plastic or thin sheet metal pipes used to move air throughout a structure

C. Duct system — Consists of registers, ducts, and a plenum (a chamber that joins several ducts to an air inlet or outlet)

FIGURE 1



D. Thermostat — Temperature control device

Examples: Cooling thermostat — Controls air conditioning
Zone control system — Controls parts of building

E. Solar collector — Converts solar radiation into thermal energy

F. Insulation — Materials used to inhibit the passage of heat, cold, and sound. Most commonly used in walls, ceilings, floors, and often wrapped around pipes.

G. R-value — Measure of resistance to heat flow

H. Utilities — Include heating ducts, lines for electricity and gas, and pipes for water and sewage

I. Uniform plumbing code — Guide for plumbing design and insulation requirements

J. National Electrical Code — Guide for minimum electrical safety standards

INFORMATION SHEET

II. Types of energy used in construction

A. Nonrenewable energy sources

Examples: Oil, gas, coal

(NOTE: These energy sources are limited in quantity and can be used up.)

B. Renewable energy sources

Examples: Sun, wind, water

(NOTE: Solar energy has the most usable application for construction technology at this time. Research is continuing for other sources.)

III. Climate control processes

A. Heating — Heat converters are used to warm air and water. A heat producer and exchanger is needed to accomplish this. In a combustion chamber, fuel and air are burned. After heat is produced, it is distributed within the structure by ducts.

Energy examples: Wood, coal, gas, oil, electricity

B. Cooling — Air conditioning removes heat from the air. The heat is released outside the building. Air conditioners also remove water vapor. The water vapor condenses to liquid form which is also released outside the structure.

Energy examples: Electricity, gas

C. Ventilating — The process of using fans to replace moist, hot, or polluted air with drier, cooler, or cleaner air

Examples: Humidifiers, dehumidifiers, air exchangers, filters, and electronic air cleaners

(NOTE: Climate control systems provide pure air at the best temperature and relative humidity. The temperature is adjusted with heating and cooling systems.)

IV. Types of solar systems (Transparencies 1 and 2)

(NOTE: The use of solar energy is becoming more attractive because conventional fuels are increasing in cost and have uncertain availability. Solar energy does not present the environmental problems associated with other fuels.)

A. Active solar — Requires the use of pumps, motors, and blowers. They use collectors, valves, pipes, electrical control, and some form of heat storage. These elements form a system that collects, stores, and distributes solar energy.

B. Passive solar — This system has few if any moving parts and allows solar energy to enter through windows and glass-covered walls. Heat is stored in floors and walls that are masses of concrete or brick or cylinders of water.

INFORMATION SHEET

V. **Purposes of plumbing systems**

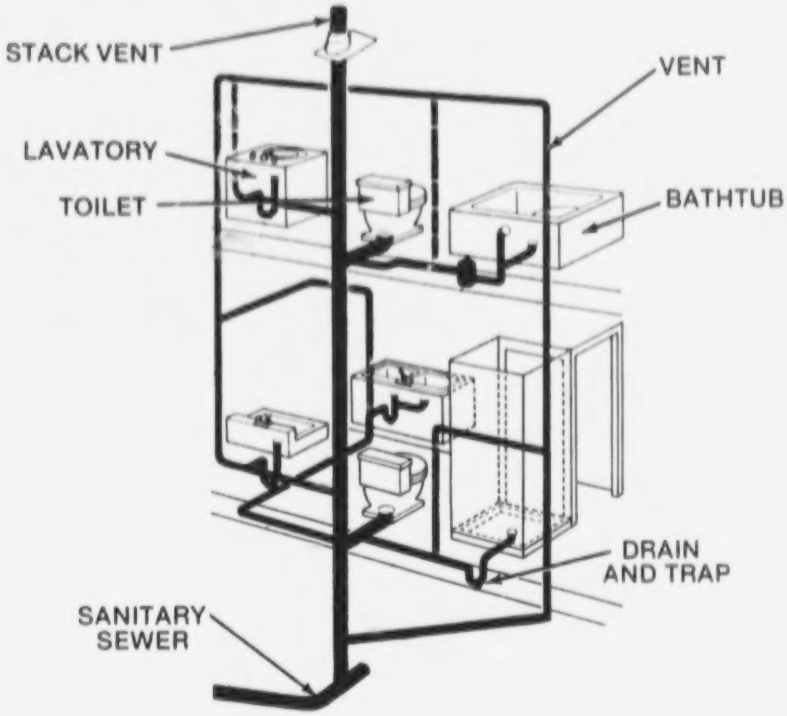
(NOTE: These systems must be designed, installed, tested, and inspected.)

A. Provide fresh hot and cold water

(NOTE: In providing hot water plumbers commonly work with gas and electricity as energy sources.)

B. Remove waste water.

FIGURE 2 — Typical residential plumbing system


STACK VENT
VENT
LAVATORY
TOILET
BATHTUB
DRAIN
AND TRAP
SANITARY
SEWER

VI. **Uses of electrical systems**

A. Electrical power

1. For mechanical equipment
2. For heating and cooling
3. For lighting
4. For electrical appliances

INFORMATION SHEET

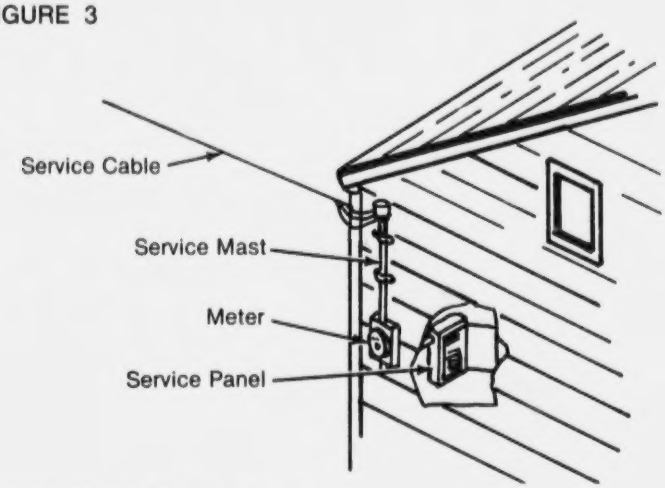
B. Communication systems

(NOTE: These systems use lower voltage and smaller wires.)

1. Door bells
2. Monitoring systems
3. Exchange systems
4. Telephone systems

(NOTE: The major parts of this system include source, service entrance, and branch circuits. The power company supplies power to the house. The subcontractor installs the mast (with wire), meter base, service panel, and branch circuits. These systems must be designed, installed, tested, and inspected.)

FIGURE 3



VII. Phases of finishing a project

A. Interior finishing — After the utilities are in, the finishing operation may be completed.

1. Insulation is needed in outside walls of a structure in most parts of the country.

   (NOTE: Kinds of insulation include insulation batts, insulation blankets, foam-in-place, loose, and rigid board insulation.)

2. Drywall, plaster, or paneling is applied to the interior walls.

   (NOTE: This will receive a final finish of paint or wallpaper later.)

INFORMATION SHEET

3. Trim and finish work including doors, their casings, trim work, and cabinet construction.

4. Floors — Finished floors include hardwood, tile, or carpet

5. Fixtures — Include plumbing and light fixtures

B. Exterior finishing — Outside finishing is being accomplished at the same time as the interior. The main operation here is exterior wall finish.

(NOTE: Exterior walls may be finished in wood, aluminum, plastic, or masonry.)

C. Landscaping — To make the grounds around the structure attractive and useful

1. Ground is graded.

(NOTE: This is done to make the ground slope away from the structure for good drainage.)

2. Topsoil is spread.

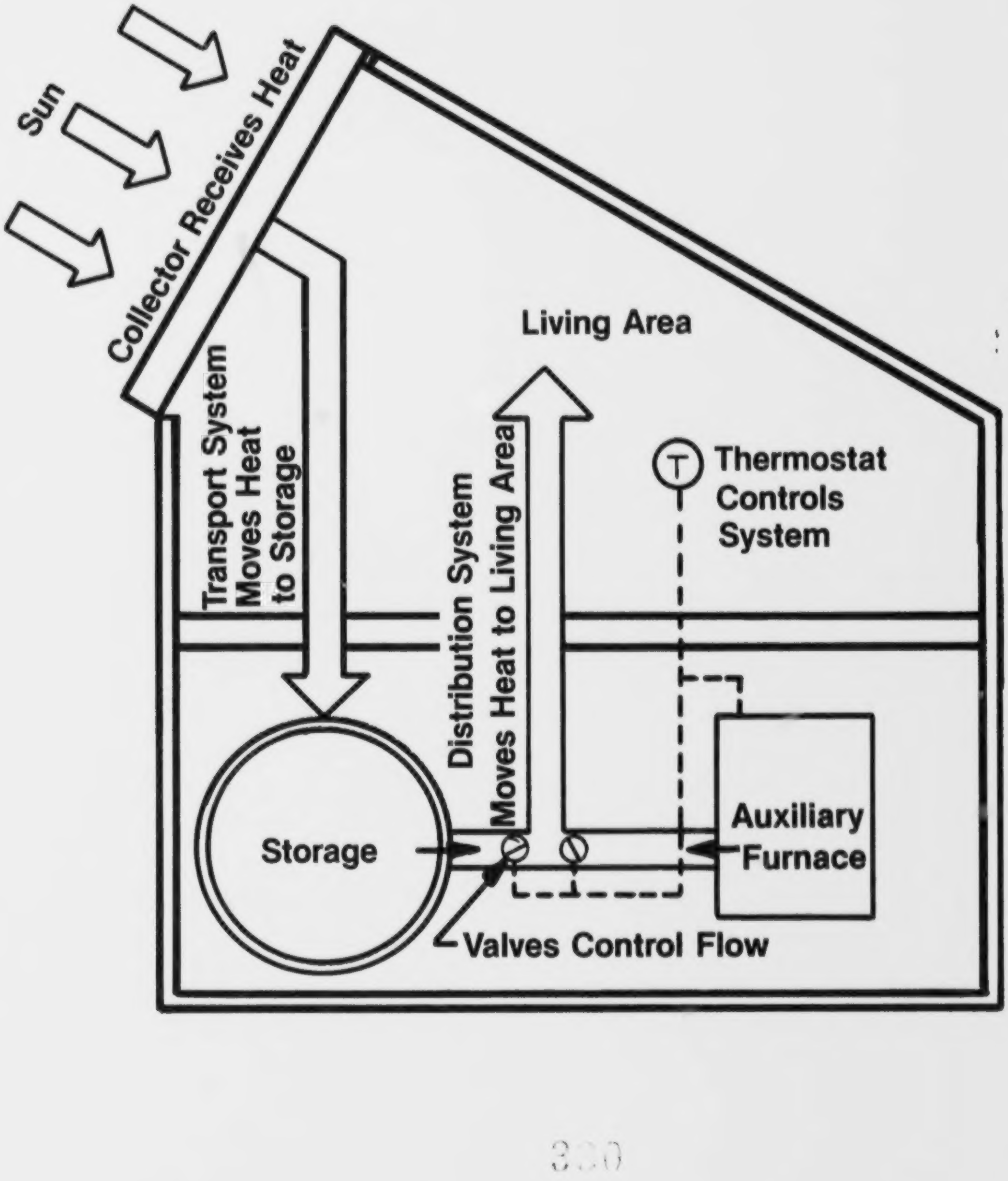
(NOTE: This allows a lawn to be established.)

3. Trees or shrubbery are planted.

(NOTE: These provide shade and privacy as well as eye appeal for the structure. Trees and shrubbery also help lower the noise level coming from the street.)

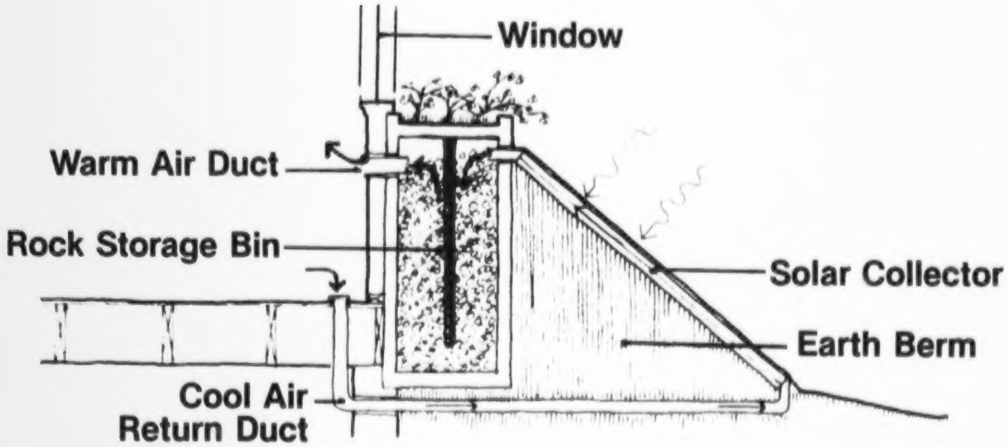
Active Solar System

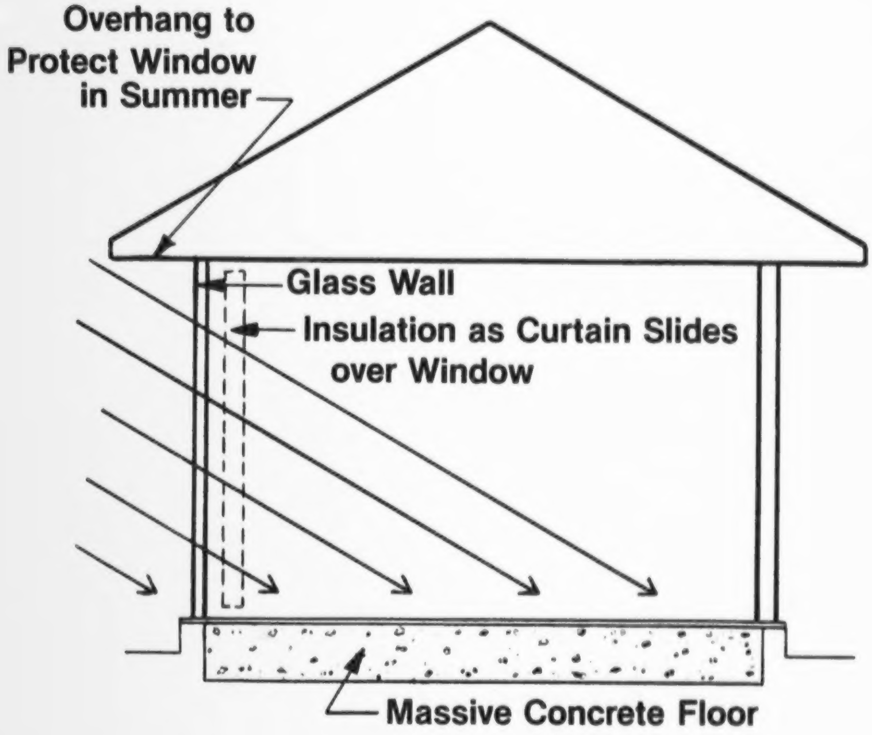
(Heating)


Sun
Collector Receives Heat
Transport System Moves Heat to Storage
Living Area
Distribution System Moves Heat to Living Area
Thermostat Controls System
Storage
Auxiliary Furnace
Valves Control Flow

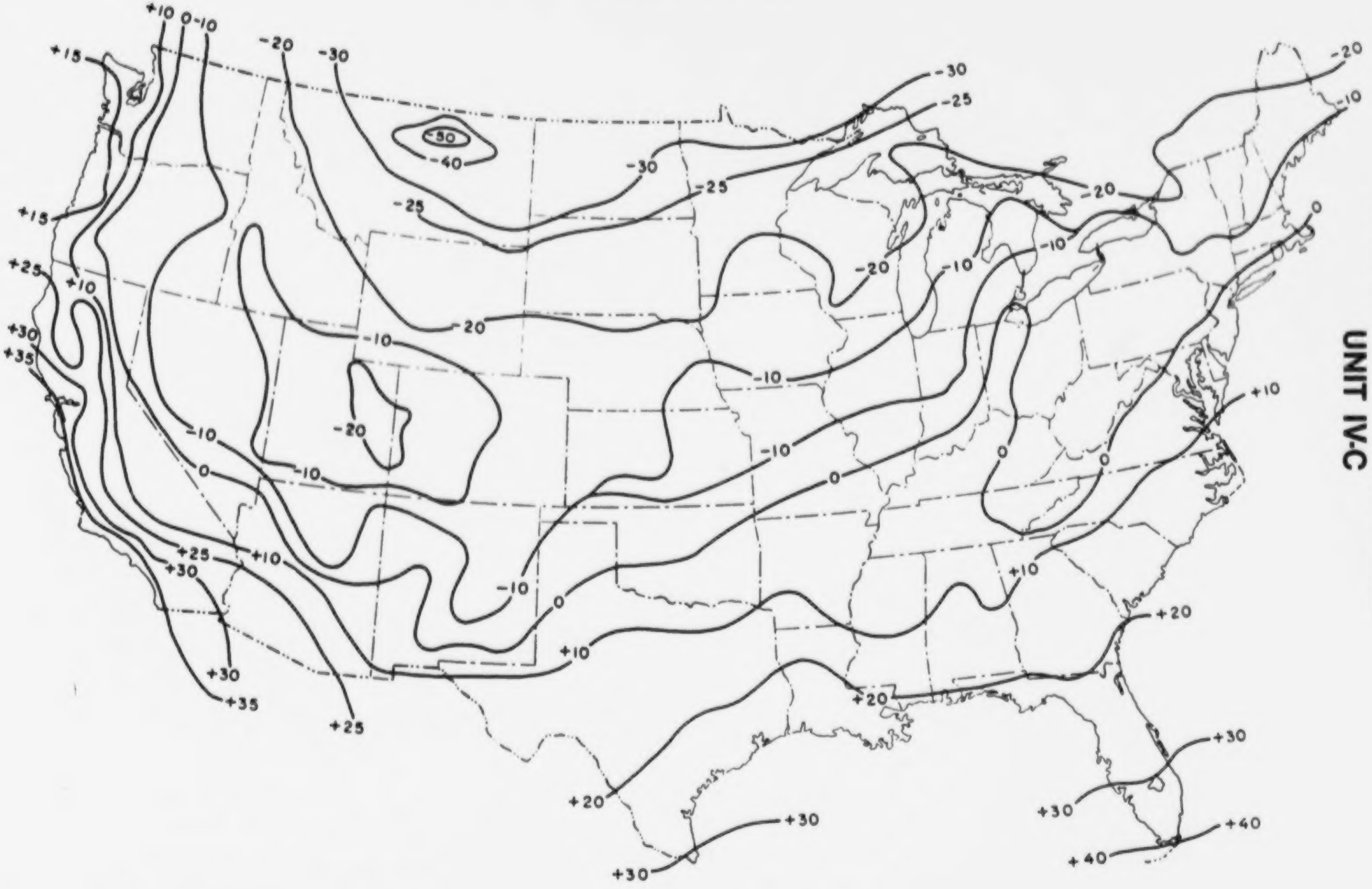
Passive Solar System

(Heating)


Window
Warm Air Duct
Rock Storage Bin
Solar Collector
Earth Berm
Cool Air Return Duct


Overhang to Protect Window in Summer
Glass Wall
Insulation as Curtain Slides over Window
Massive Concrete Floor

HANDOUT #1 — AVERAGE LOW TEMPERATURES IN THE UNITED STATES



+10
0
-10
-20
-30
+15
-50
-40
-25
-30
-25
-20
-10
+15
+25
+10
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-10
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+35
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+10
+20
+30
+35
+25
+20
+30
+30
+30
+30
+40
+40

FINISHING THE STRUCTURE
UNIT IV-C

HANDOUT #2 — INSULATION R-VALUES REQUIRED TO MEET COMFORT STANDARDS

Standard	Insulation Location	Insulation R-Value
All-weather comfort standard	Walls	R 19
	Ceilings	R 30
	Floors	R 19
Moderate comfort standard	Walls	R 13
	Ceilings	R 26
	Floors	R 13
Minimum comfort standard	Walls	R 11
	Ceilings	R 19
	Floors	R 11

FINISHING THE STRUCTURE
UNIT IV-C

JOB SHEET #1 — BUILD AND OPERATE A PASSIVE SOLAR COLLECTOR

A. Tools and equipment

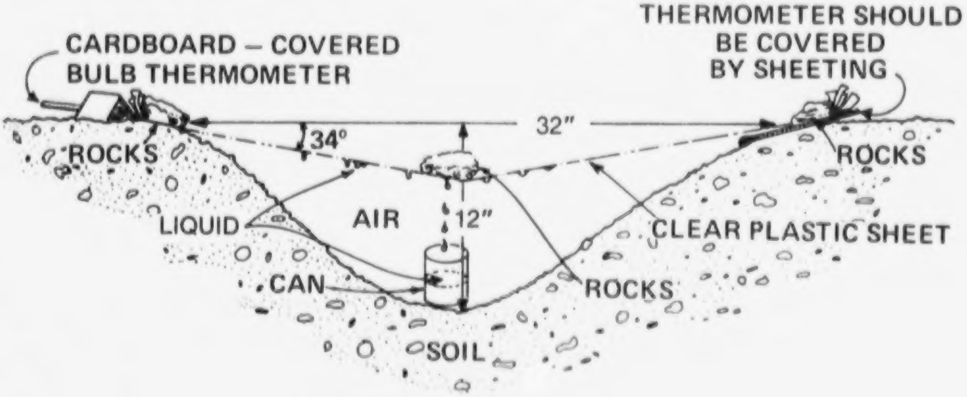
1. Strong, flexible, transparent plastic sheet at least 39 inches square

   (NOTE: Plastic storm window covering will do.)
2. Several fist-size rocks
3. Shovel
4. Two thermometers
5. Wristwatch or stopwatch
6. Piece of cardboard large enough to cover half a thermometer
7. Graph paper
8. Collecting vessel or graduated cylinder
9. Cobalt chloride test paper (optional)
10. Protractor

B. Procedure

1. Dig a hole about 32″ in diameter and 12″ deep, and place the soil to one side.
2. Center the graduated cylinder or collecting vessel in the bottom of the hole. (Figure 1)

FIGURE 1


CARDBOARD – COVERED BULB THERMOMETER
THERMOMETER SHOULD BE COVERED BY SHEETING
34°
32″
ROCKS
ROCKS
LIQUID
AIR
12″
CLEAR PLASTIC SHEET
CAN
ROCKS
SOIL

Courtesy U.S. Department of Energy

JOB SHEET #1

3. Place the plastic sheet over the hole and firmly anchor one edge with small rocks.

4. Place one small rock in the center of the plastic sheet directly over the collecting vessel, while allowing the plastic sheet to stretch to at least a 34° angle from the horizon.

   (NOTE: Have another student help with this step; one should manage the weighted plastic sheet while the other uses the protractor to properly attain the correct angle.)

5. Seal the outer edge of the plastic sheet with soil and small rocks.

6. Insert one thermometer under the plastic sheet with the bulb extending into the air chamber beneath the plastic sheet.

   (NOTE: Be sure to position the thermometer so the scale can be read.)

7. Place the other thermometer at the other edge of the sheet, cover the half of the thermometer with the bulb on it with cardboard, and position the thermometer so the scale can be read.

8. Simultaneously record the temperatures of both the inside and the outside thermometers at two-minute intervals.

9. Enter your readings in the following data table:

Reading #	Inside Thermometer	Outside Thermometer
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

10. Remove the plastic sheet after 20 minutes have passed.

JOB SHEET #1

11. Retrieve the collecting vessel.

12. Pour the contents of the collecting vessel into a graduated cylinder and record the amount of liquid collected in milliliters (ml).

13. Check the liquid collected to determine its identity.

    (NOTE: Cobalt chloride paper may be used for this test, but chances are you can identify the liquid with no great difficulty.)

14. Fill in the hole and return the shovel and other equipment to a proper storage area.

15. Answer the following questions:

    a. Where did the liquid come from? ____________________

    b. Why did the liquid collect on the underside of the plastic sheet?

    ____

    c. Why did the liquid drip into the collecting vessel? ____________________

    ____

    d. How did solar energy cause the collector to operate? ____________________

    ____

    e. If you were stranded in the desert with no water, and had the proper equipment in your survival gear, would this be a worthwhile activity?

    ____

    f. What do the readings in your data table reflect concerning the operation of a solar collector?

    ____

FINISHING THE STRUCTURE
UNIT IV-C

JOB SHEET #2 — FINISH THE STRUCTURE

NAME ____ SCORE ____________

(NOTE: The finishing procedure should be in accordance with the project constructed in Unit III-C, Job Sheet #5.)

A. Tools and materials — As required for construction

B. Procedure

1. Complete utility systems as required.
2. Complete interior as required.
3. Complete exterior as required.
4. Clean and store tools and materials as directed by instructor.

FINISHING THE STRUCTURE
UNIT IV-C

PRACTICAL TEST
JOB SHEET #1 — BUILD AND OPERATE A PASSIVE SOLAR COLLECTOR

STUDENT'S NAME ______________________________ DATE __________

EVALUATOR'S NAME ______________________________ ATTEMPT NO. ______

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the material and try again.)

The student:	YES	NO
1. Checked out proper tools.	____	____
2. Followed instructor's directions.	____	____
3. Kept an accurate log of readings.	____	____
4. Checked in/put away tools and materials.	____	____
5. Cleaned the work area.	____	____
6. Used proper tools correctly.	____	____
7. Performed steps in a timely manner. (___hrs.___min.___sec.)	____	____
8. Practiced safety rules throughout procedure.	____	____
9. Provided satisfactory responses to questions asked.	____	____

EVALUATOR'S COMMENTS: ____

____

PRACTICAL TEST

JOB SHEET #1

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
Successfully built a passive solar collector	4	3	2	1
Successfully kept temperature records	4	3	2	1
Collected liquid	4	3	2	1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

- 4 — Skilled — Can perform job with no additional training.
- 3 — Moderately skilled — Has performed job during training program; limited additional training may be required.
- 2 — Limited skill — Has performed job during training program; additional training is required to develop skill.
- 1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR'S NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

FINISHING THE STRUCTURE
UNIT IV-C

PRACTICAL TEST
JOB SHEET #2 — FINISH THE STRUCTURE

STUDENT'S NAME ________________________________ DATE ____________

EVALUATOR'S NAME ________________________________ ATTEMPT NO. ______

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the material and try again.)

The student:		YES	NO
1.	Checked out proper tools.	____	____
2.	Worked well as a construction crew member.	____	____
3.	Performed task to the best of ability.	____	____
4.	Followed directions correctly.	____	____
5.	Checked in/put away tools and materials.	____	____
6.	Cleaned the work area.	____	____
7.	Used proper tools correctly.	____	____
8.	Performed steps in a timely manner. (___hrs.___min.___sec.)	____	____
9.	Practiced safety rules throughout procedure.	____	____
10.	Provided satisfactory responses to questions asked.	____	____

EVALUATOR'S COMMENTS: ____

____

PRACTICAL TEST

JOB SHEET #2

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:	4	3	2	1
Produced a quality finished structure				

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled — Can perform job with no additional training.
3 — Moderately skilled — Has performed job during training program; limited additional training may be required.
2 — Limited skill — Has performed job during training program; additional training is required to develop skill.
1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR'S NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

FINISHING THE STRUCTURE
UNIT IV-C

NAME ____________________________ SCORE ______________________

TEST

1. Match the terms on the right with their correct definitions.

_____a. A device that can heat or cool a building by taking heat from one place to another

_____b. Plastic or thin sheet metal pipes used to move air throughout a structure

_____c. Consists of registers, ducts, and a plenum

_____d. Temperature control device

_____e. Converts solar radiation into thermal energy

_____f. Materials used to inhibit the passage of heat, cold, and sound

_____g. Measure of resistance to heat flow

_____h. Include heating ducts, lines for electricity and gas, and pipes for water and sewage

_____i. Guide for plumbing design and insulation requirements

_____j. Guide for basic minimum electrical standards

1. Insulation
2. Solar collector
3. Heat pump
4. Valves
5. Thermostat
6. Blower fan
7. R-value
8. Ducts
9. Water heater
10. Uniform Plumbing Code
11. Auxiliary furnace
12. Duct system
13. Dead air space
14. National Electric Code
15. Utilities

2. Two types of energy used in construction are ____________ and ____________ sources.

TEST

3. Discuss the following climate control processes.

   a. Heating — ______________________________

   ____

   ____

   b. Cooling — ______________________________

   ____

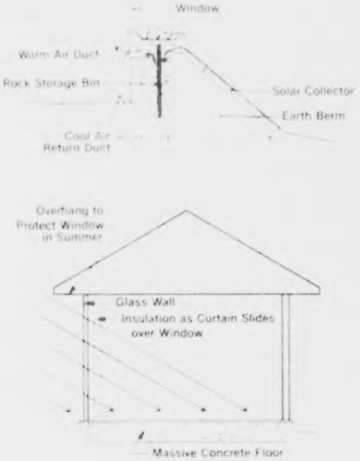
   ____

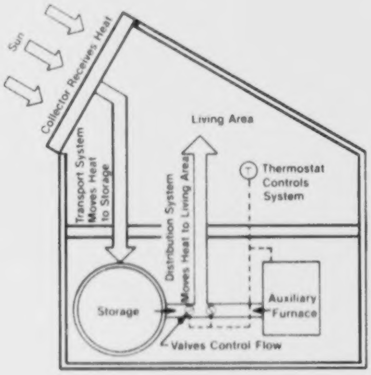
   c. Ventilating — ______________________________

   ____

   ____

4. Distinguish between the two types of solar systems by labeling the pictures below.


Window
Warm Air Duct
Rock Storage Bin
Solar Collector
Earth Berm
Cool Air Return Duct
Overhang to Protect Window in Summer
Glass Wall
Insulation as Curtain Slides over Window
Massive Concrete Floor


Sun
Collector Receives Heat
Transport System Moves Heat to Storage
Living Area
Distribution System Moves Heat to Living Area
Thermostat Controls System
Storage
Auxiliary Furnace
Valves Control Flow

a. ______________________ b. ______________________

TEST

5. Select from the following list the purposes of plumbing systems by placing an "X" next to the correct purposes.

______a. Provide fresh hot and cold water

______b. Provide electricity

______c. Remove waste water

______d. Provide adequate ventilation

6. State the two major uses of electrical systems.

a. ____

b. ____

7. List three phases of finishing a project.

a. ____

b. ____

c. ____

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

8. Demonstrate the ability to:

a. Build and operate a passive solar collector. (Job Sheet #1)

b. Finish the structure. (Job Sheet #2)

FINISHING THE STRUCTURE
UNIT IV-C

ANSWERS TO TEST

1.

a.	3	f.	1
b.	8	g.	7
c.	12	h.	15
d.	5	i.	10
e.	2	j.	14

2. Renewable and nonrenewable

3. Discussion should include the following:
   a. Heating — Heat converters are used to warm air and water. A heat producer and exchanger is needed to accomplish this. In a combustion chamber, fuel and air are burned. After heat is produced, it is distributed within the structure by ducts.
   b. Cooling — Air conditioning removes heat from the air. The heat is released outside the building. Air conditioners also remove water vapor. The water vapor condenses to liquid form which is also released outside the structure.
   c. Ventilating — The process of using fans to replace moist, hot, or polluted air with drier, cooler, or cleaner air.
   (NOTE: Answers will vary. Evaluate to instructor's satisfaction.)

4. a. Passive solar
   b. Active solar

5. a, c

6. a. Electrical power
   b. Communication system

7. a. Interior finishing
   b. Exterior finishing
   c. Landscaping

8. Performance skills evaluated to the satisfaction of the instructor

INTRODUCTION TO MANUFACTURING
UNIT I-D

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify the purpose of and describe the major components of a manufacturing system. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to manufacturing with the correct definitions.
2. Complete statements concerning a historical perspective of manufacturing.
3. Differentiate between production, manufacturing, and construction.
4. Discuss the roles of transportation and communication in production.
5. Categorize the components of a manufacturing system according to the universal system model.
6. Match the areas of a manufacturing organization with the correct functions.
7. Match manufacturing divisions with the correct job titles.
8. Discuss the relationship between management and organizational structure.
9. Distinguish between the types of organizational structures.
10. Discuss the purpose of each of the general safety rules.

OBJECTIVE SHEET

11. Participate in a mass production assembly operation. (Assignment Sheet #1)
12. Identify major movements that contributed to the Industrial Revolution. (Assignment Sheet #2)
13. Research and write about an inventor or invention that contributed to the Industrial Revolution. (Assignment Sheet #3)
14. Identify and gather information about two businesses in your community. (Assignment Sheet #4)
15. Describe societal needs that the manufacturing industry has addressed during the last two centuries. (Assignment Sheet #5)
16. Research a manufacturing technology career. (Assignment Sheet #6)
17. Demonstrate group problem solving skills during simulation activities in the laboratory. (Assignment Sheet #7)
18. Identify an organizational structure that is appropriate for use in a classroom manufacturing activity. (Assignment Sheet #8)

INTRODUCTION TO MANUFACTURING
UNIT I-D

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Assignment Sheet #1 should be conducted the **first** day of class. One type of activity would be as follows:

    a. Materials needed:

        1) 20-30 inexpensive ball-point pens ("click" type) — one for each student

        2) Stop watch or timer

    b. Procedure:

        1) Disassemble all ball-point pens.

        2) Divide the class into two groups. Identify each group with a specific name.

        3) Tell each group that they must assemble 10-15 ball-point pens and the operation will be timed.

        4) Indicate that each group will be given five minutes to plan the assembly operation.

        5) After the planning time, start the competition and time the groups.

        6) Upon completion share the times and examine the "products" to determine the rate of rejection.

        7) Discuss how improvements could have been made to the process.

SUGGESTED ACTIVITIES

c. Options:

1) Have one group make each individual responsible for a certain number of pens and the other group use an assembly line operation.

2) Use other products such as unfolded cartons, jars of sand, etc.

3) Do not provide planning time.

2. Show films or videotapes dealing with manufacturing and careers. Possible films are listed on the next page.

3. Discuss the importance of all curriculum areas when studying manufacturing. Provide examples whenever possible.

4. When identifying an organizational structure (Assignment Sheet #8), divide the class into groups of 5 or 6 and have these groups arrive at a consensus. Then have each group present their proposed structure and select one by class vote.

5. Whenever group activities are used, point out that personalities and individuals are not important. Ideas are important and their source should not be considered. You may want to institute a policy where ideas must be presented by individuals who did not originate the idea.

6. Take a field trip to a local manufacturing company.

7. Have a local industry representative talk to your class about company or plant organization.

8. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Bame, E. Allen and Paul Cummings. *Exploring Technology.* Worcester, MA: Davis Publications, Inc., 1980.

B. *Manufacturing.* Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc.

C. Wright, R. Thomas and Len Sterry. *Industry and Technology Education: A Guide for Curriculum Designers, Implementors, and Teachers.* Lansing, IL: Technical Foundation of America.

D. Wright, R. Thomas and Richard M. Henak. *Exploring Production.* South Holland, IL: Goodheart-Willcox Co., 1985.

E. Lux, D.G. and W.E. Ray. *The World of Manufacturing.* Bloomington, IL: McKnight and McKnight, 1971.

SUGGESTED SUPPLEMENTAL RESOURCES

A. Films

1. *Modern Corporations*, 30 min.
   Sutherland Educational Films, Inc.
   201 North Occidental Boulevard
   Los Angeles, CA 90026

2. *Functions of Industry and You*, 15 min.
   University of Illinois
   Visual Aids Service
   Champaign, IL 61820

3. *Men Who Changed the World*, 11 min.
   University of Michigan
   Audio-Visual Education Center
   Ann Arbor, MI 48106

B. Videotapes (VHS or Beta)

The following videotapes are available from:

Morris Video
413 Avenue G #1
P.O. Box 443
Redondo Beach, CA
1-800-843-3603, (213) 379-2414

1. *Management — Private Enterprise*, CS-201

2. *Automobile Manufacturing*, CS-371

3. *General Manufacturing*, CS-376

INTRODUCTION TO MANUFACTURING
UNIT I-D

INFORMATION SHEET

I. **Terms and definitions associated with manufacturing**

A. Industry — Organization that utilizes resources to produce goods and services to meet the wants and needs of individuals

Examples: Agriculture, forestry, mining, construction, manufacturing, wholesale and retail trade, finance, insurance, real estate, transportation, communication, public utilities, entertainment, government

B. Labor — Human activity or services performed by workers

C. Durable goods — Products that usually last at least three years

Examples: Furniture, refrigerators, automobiles, bicycles

D. Nondurable goods — Products that usually last fewer than three years

Examples: Clothing, food, toothpaste

E. Services — Work performed to improve material goods or to benefit people

F. Natural resources — Items taken from the earth, sea, and air

Examples: Petroleum, iron ore, cotton, lumber and wood, fruits and vegetables, natural gas, oxygen

G. Assembly — The fitting together of parts to produce manufactured goods

II. **Historical perspective of manufacturing** (Transparency 1)

A. In the past most items were produced in the home for use in the home by family members. Any excesses were sold or traded (bartered). This is referred to as the **home handicraft system.**

B. Later some people began to specialize in a craft and produced items in quantity at home that were sold to a merchant. The merchant then sold the items, along with items from other producers. This is referred to as the **mercantile system.**

C. The Industrial Revolution is the time (1750-1850) when **machines** were used to make products instead of only hand tools, and when products were made in **factories** instead of homes.

INFORMATION SHEET

III. **Production, manufacturing, and construction** (Figure 1)

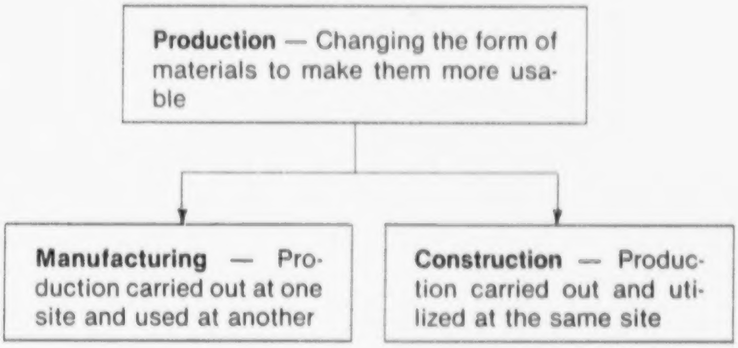
A. *Production* is defined as changing the form of materials to make them more usable.

B. It can be divided into two major types of activities.

1. *Manufacturing:* Production carried out at one site and used at another

2. *Construction:* Production carried out and utilized at the same site

FIGURE 1

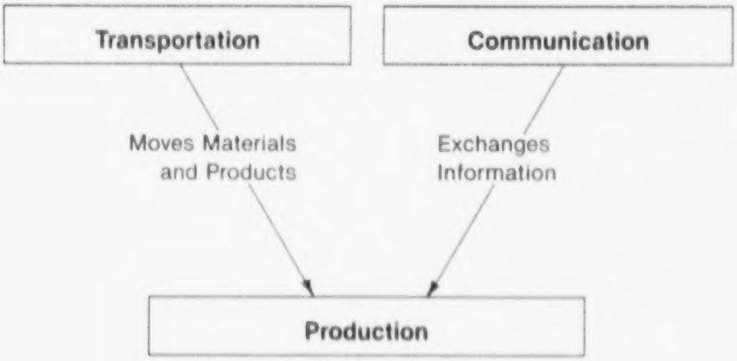

Production — Changing the form of materials to make them more usable
Manufacturing — Production carried out at one site and used at another
Construction — Production carried out and utilized at the same site

IV. **Roles of transportation and communication in production** (Figure 2)

A. Transportation technology includes the movement of materials, people, and products to and from production sites as well as during the production process.

B. Communication involves the movement of messages and information which are essential for any production. Without transportation and communication, production could not occur.

FIGURE 2

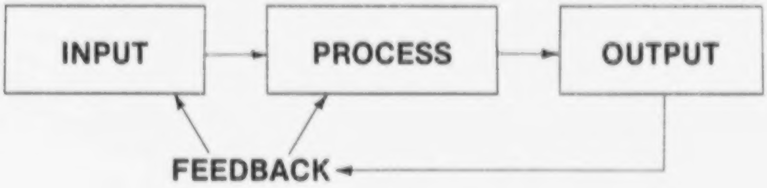

Transportation
Communication
Moves Materials and Products
Exchanges Information
Production

INFORMATION SHEET

V. **Components of a manufacturing system** (Figure 3)

The components of a manufacturing system can be classified according to the universal system model.

FIGURE 3 — Universal System Model



A. Inputs — Natural resources, finance, capital, energy, human resources, and knowledge

B. Processes — Management practices, production processes, and personnel practices

C. Outputs — Durable goods and nondurable goods

D. Feedback — Customer response, profit and loss, and quality control

VI. **Areas of a manufacturing organization and their functions** (Transparency 2)

A. Production — Actual making of the products

B. Research and development — Identifies potential new products and processes

C. Industrial relations — Personnel, labor, and public relations

D. Marketing — Concerned with selling the product

E. Financial affairs — Obtaining and managing money

INFORMATION SHEET

VII. Job titles and tasks in manufacturing divisions

(NOTE: The number of people in each division will vary.)

DIVISION	JOB TITLE	TASK
Production	• Supervisor	Oversees a major manufacturing operation.
	• Foreman	Oversees a particular group of tasks within a larger operation. Example: Finishing Room Foreman
	• Worker	Controls and/or performs tasks necessary to produce the product. Examples: Machinist, Welder, Painter, Assembly Worker
	• Quality Control Engineer	Oversees the inspection of completed products.
Research and Development	• Design Engineer	Responsible for designing new products.
	• Laboratory Technician	Responsible for fabricating and testing designs.
Industrial Relations	• Public Relations Director	Manages contacts with the environment outside the organization.
	• Personnel Director	Enforces hiring, firing, and promotion policies and maintains employee records.
	• Training director	Meets the needs for training programs by establishing and evaluating instruction efforts.

INFORMATION SHEET

DIVISION	JOB TITLE	TASK
Marketing	• Advertising Manager	Coordinates the advertising of products and services.
	• Graphic designer	Designs and prepares advertisements.
	• Sales manager	Directs the efforts to sell the products and services.
	• Salesperson	Contacts potential product and service consumers.
Financial Affairs	• Comptroller	Determines procedures and makes decisions regarding financial matters pertaining to the company.
	• Accountant	Maintains records of the organization's financial performance.

(NOTE: There are many other jobs in addition to these.)

VIII. **Relationship between management and organizational structure**

A. Management has been defined as "getting things done through people."

B. In order to "get things done" efficiently, an organizational structure must be identified or created.

C. One of the major purposes of such a structure is to divide the major organizational tasks into subtasks and identify the responsibilities of individuals within the organization.

IX. **Types of organizational structures** (Transparencies 3 and 4)

A. Line organization

1. Provides a single line of authority from the president down through the workers in each functional division.
2. Such a structure is best suited for small companies.

INFORMATION SHEET

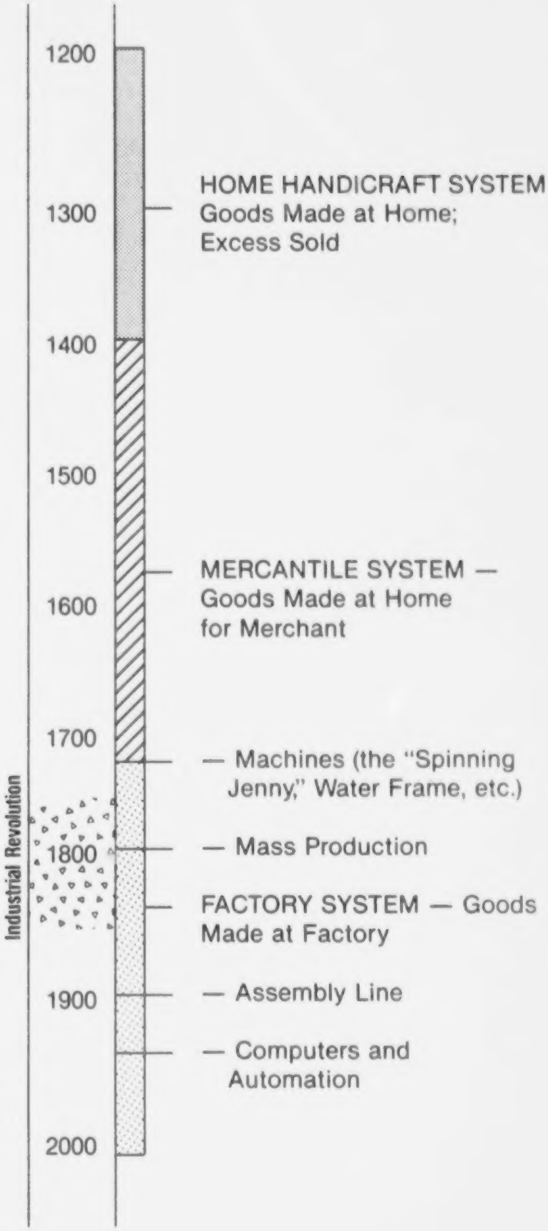
- B. Line and staff organization
    - 1. Necessary in larger companies.
    - 2. Higher level managers have advisors that help in the decision making process.
- C. Line and functional staff organization
    - 1. Changes the upper middle manager's role from advisory to decision-making.
    - 2. These managers are able to run their area with a minimum of input from the upper level.
    - 3. Best suited for very large companies.

X. **Safety precautions to help prevent accidents** (Transparency 5)

- A. Wear eye protection at all times while in lab.
- B. Walk, do not run, in lab areas.
- C. Be considerate of others' safety.
- D. Do not use tools or equipment without receiving instructions for safe use.
- E. Never throw objects in lab.
- F. Store flammable materials or caustic liquids in approved safety containers.
- G. Keep lab area neat and orderly.

Historical Perspective of Manufacturing

(Major Milestones)


1200
1300
1400
1500
1600
1700
1800
1900
2000
Industrial Revolution

HOME HANDICRAFT SYSTEM — Goods Made at Home; Excess Sold

MERCANTILE SYSTEM — Goods Made at Home for Merchant

— Machines (the "Spinning Jenny," Water Frame, etc.)

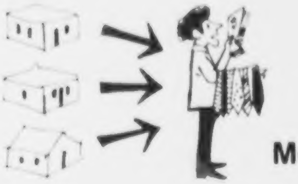
— Mass Production

FACTORY SYSTEM — Goods Made at Factory

— Assembly Line

— Computers and Automation

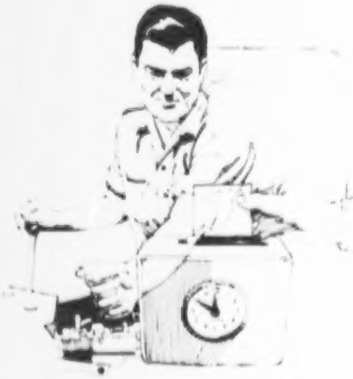
Family



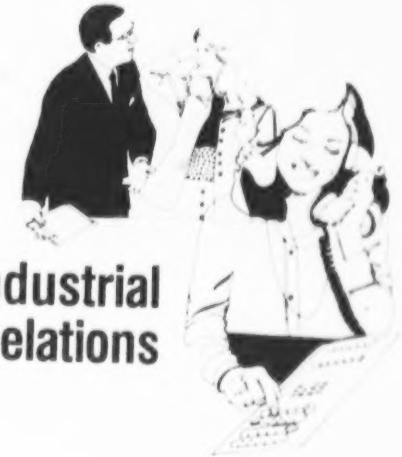
Merchant

Factory

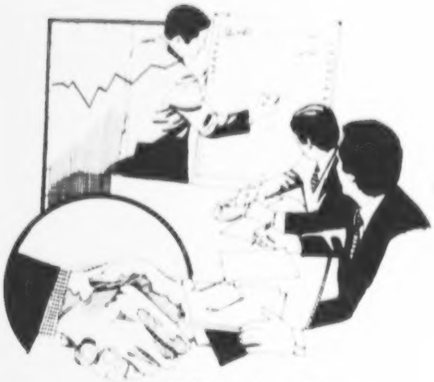
Areas of a Manufacturing Organization



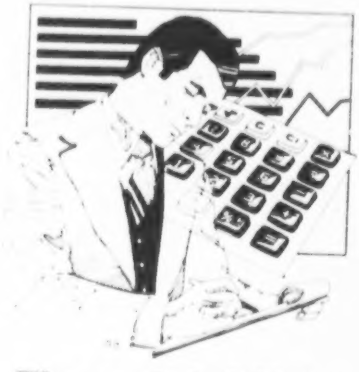
Production



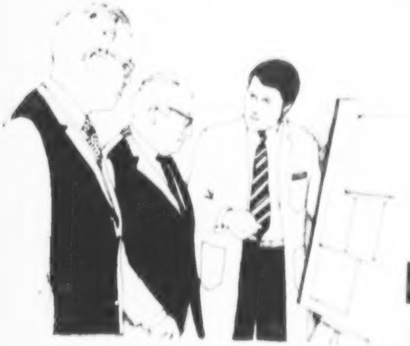
Industrial Relations



Marketing

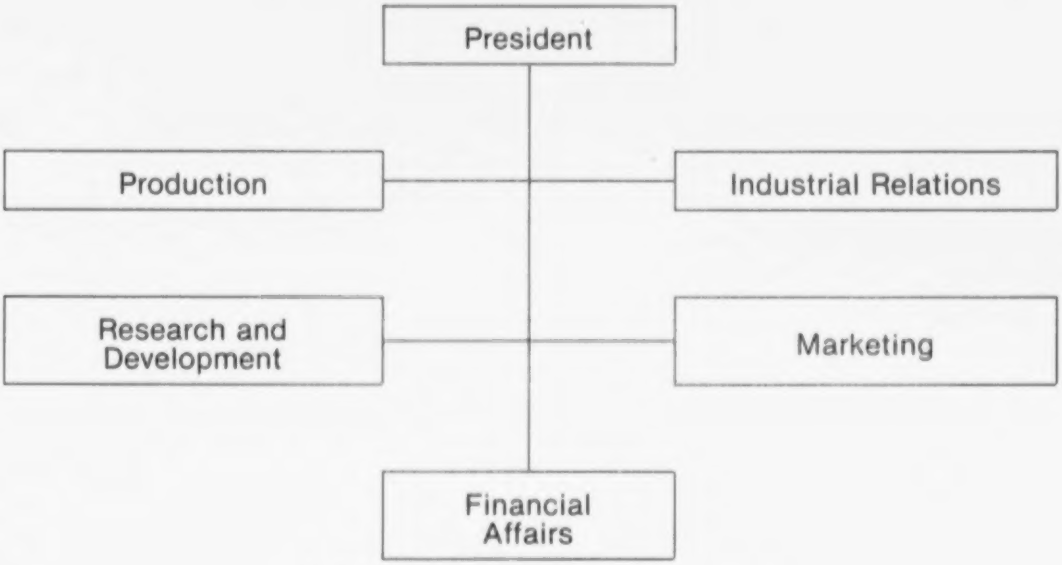


Financial Affairs

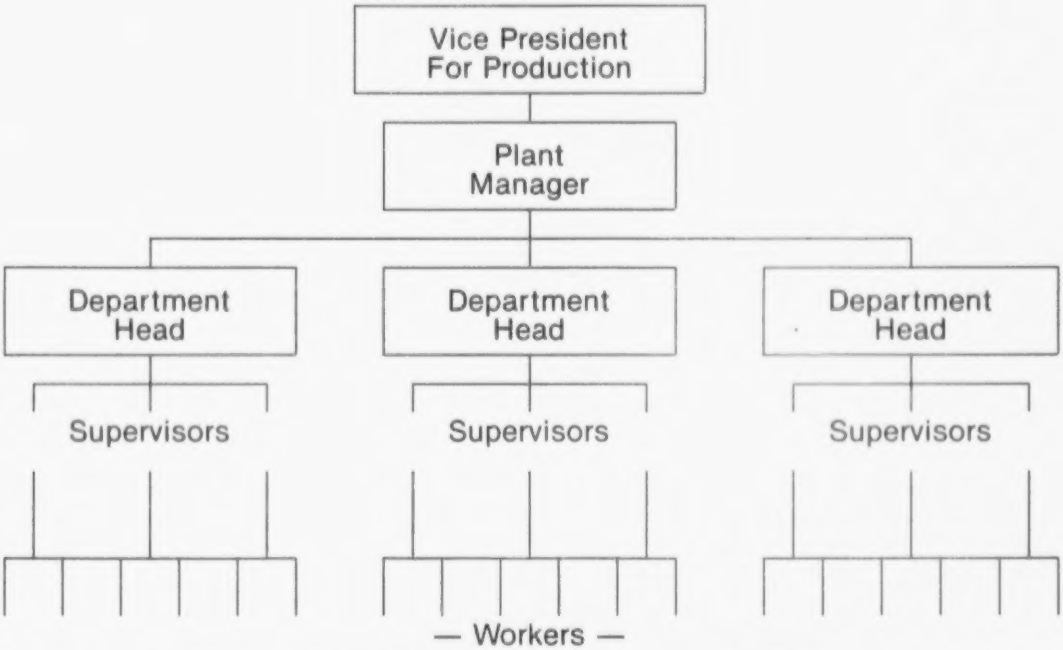


Research and Development

Organizational Structures


President
Production
Industrial Relations
Research and Development
Marketing
Financial Affairs

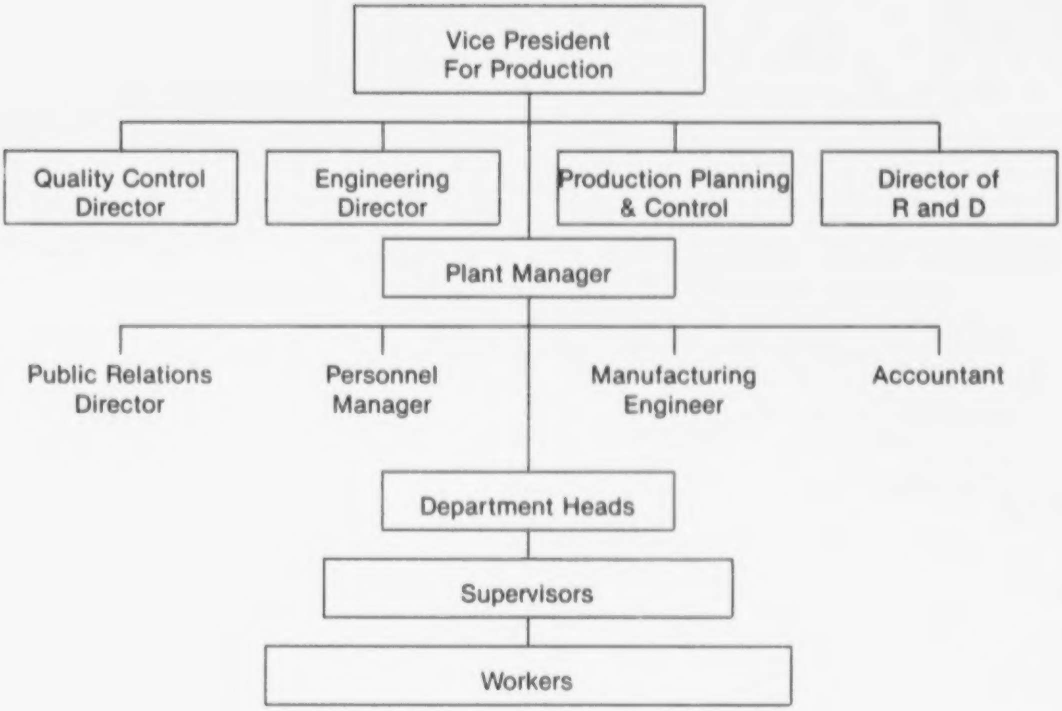
Line Organization


Vice President For Production
Plant Manager
Department Head
Department Head
Department Head
Supervisors
Supervisors
Supervisors
— Workers —

Line and Staff Organization

Organizational Structures

(Continued)



Vice President
For Production

Quality Control
Director

Engineering
Director

Production Planning
& Control

Director of
R and D

Plant Manager

Public Relations
Director

Personnel
Manager

Manufacturing
Engineer

Accountant

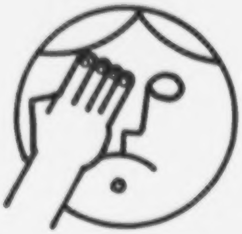
Department Heads

Supervisors

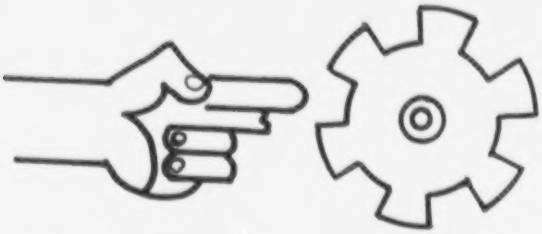
Workers

Line and Functional Staff Organization

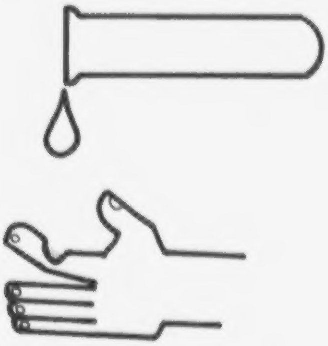
Laboratory Hazards



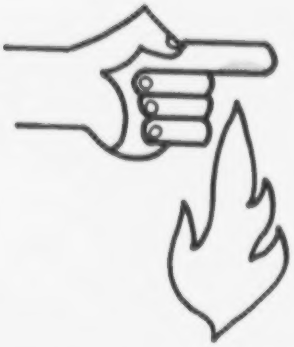
Unprotected Eyes



Dangerous Machines



Caustic Chemicals



Flammable Materials

INTRODUCTION TO MANUFACTURING
UNIT I-D

ASSIGNMENT SHEET #1 — PARTICIPATE IN A MASS PRODUCTION ASSEMBLY OPERATION

NAME ______________________________ SCORE ____________

Directions: Your instructor will divide your class into two groups and identify a task that each group is to perform. After the groups have completed this task, answer the following questions.

1. What is the name of your group?

   ____

2. How long did it take your group to complete the task?

   ____________ minutes ____________ seconds

3. Was your group faster or slower than the other group?

   ____

4. Why was your group faster or slower?

   ____

   ____

   ____

   ____

5. How could your group have improved its time?

   ____

   ____

   ____

   ____

ASSIGNMENT SHEET #1

6. Describe another assembly operation that you have seen or heard of that is similar to this classroom exercise and occurs in industry.

INTRODUCTION TO MANUFACTURING
UNIT I-D

ASSIGNMENT SHEET #2 — IDENTIFY MAJOR MOVEMENTS THAT CONTRIBUTED TO THE INDUSTRIAL REVOLUTION

NAME ______________________________ SCORE ____________

The Industrial Revolution had a tremendous impact on society as we know it. The migration from the farms to the cities is well documented. Using resources in the library and from your history classes, explain why the following conditions may have contributed to this revolution.

(NOTE: Use complete sentences when completing this assignment.)

1. Condition or event: Existence of the home handicraft system

   Why this contributed: ______________________________

2. Condition or event: Existence of the mercantile or "putting out" system

   Why this contributed: ______________________________

INTRODUCTION TO MANUFACTURING
UNIT I-D

ASSIGNMENT SHEET #3 — RESEARCH AND WRITE ABOUT AN INVENTOR OR INVENTION THAT CONTRIBUTED TO THE INDUSTRIAL REVOLUTION

NAME ______________________________ SCORE __________

Directions: Select one of the following inventors or inventions or one provided by your instructor, and write a brief summary below. Be prepared to read your summary aloud in front of the class.

A. Inventors/inventions

- Spinning jenny
- James Watt
- Samuel Slater
- Charles Hall
- Simeon North
- Henry Ford
- Labor unions
- Lillian and Frank Gilbreth
- Thomas Edison

B. Points to cover

1. Who was the inventor?
2. What was the invention?
3. How was it an advantage over the old method?
4. Is the invention still in use?

____

____

____

____

____

____

____

____

____

INTRODUCTION TO MANUFACTURING
UNIT I-D

ASSIGNMENT SHEET #4 — IDENTIFY AND GATHER INFORMATION ABOUT TWO BUSINESSES IN YOUR COMMUNITY

NAME ______________________________ SCORE __________

Directions: Look around you in your community and write down the names of two business firms that you know of. Make sure at least one is a manufacturing firm. Write their names and other information on the following form:

BUSINESS NO. 1

Name of Firm: ______________________________

Function of this firm:

____

Name of owner: ______________________________

Name of president of firm: ______________________________

Number of employees: ______________________________

Product handled: ______________________________

Does this firm actually make the product it sells? ______________________________

If no, then who does make it? ______________________________

BUSINESS NO. 2

Name of Firm: ______________________________

Function of this firm:

____

Name of owner: ______________________________

Name of president of firm: ______________________________

Number of employees: ______________________________

Product handled: ______________________________

Does this firm actually make the product it sells? ______________________________

If no, then who does make it? ______________________________

INTRODUCTION TO MANUFACTURING
UNIT I-D

ASSIGNMENT SHEET #5 — DESCRIBE SOCIETAL NEEDS THAT THE MANUFACTURING INDUSTRY HAS ADDRESSED DURING THE LAST TWO CENTURIES

NAME ______________________________ SCORE __________

Since the Industrial Revolution has virtually eliminated the independent farm family that raised its own food and made its own clothes, how has manufacturing served the needs of the dependent family units in our society?

Directions: Complete the following chart. Needs are listed on the left and the response by the manufacturing industry should be listed on the right.

NEED	RESPONSE BY INDUSTRY
Example: Bread (food)	Sliced bread, cooked rolls, frozen bread dough, etc.
1. Entertainment	
2. Travel	
3. Education	
4. Housing	
5. Food preparation	

INTRODUCTION TO MANUFACTURING
UNIT I-D

ASSIGNMENT SHEET #6 — RESEARCH A MANUFACTURING TECHNOLOGY CAREER

NAME ________________________________ SCORE __________

Directions: Examples of careers in the manufacturing field were discussed in Information Sheet, Section VII. You may be able to name other careers also. Select a career you think you would be good in. Research for more details.

Examples:

1. What is the exact training needed?
2. Where can you get that training?
3. What are the working conditions for that job?
4. What are the future possibilities of employment?
5. Why would you be good at that job?

Compile the results of your research and present it either in written or oral form as requested by your instructor.

INTRODUCTION TO MANUFACTURING
UNIT I-D

ASSIGNMENT SHEET #7 — DEMONSTRATE GROUP PROBLEM SOLVING SKILLS DURING SIMULATION ACTIVITIES IN THE LABORATORY

NAME ____ SCORE ____________

One of the most difficult functions of manufacturing organizations is financial affairs. Securing capital to begin or expand operations is a continual problem for most companies.

Directions: Identify ways of financing a company that could be set up in your classroom. The conditions are:

1. You have identified a product that can be produced within your laboratory.
2. Approximately $120.00 will be needed to finance the venture.
3. It is anticipated the processes will take approximately three weeks.

Your assignment is to divide up (under the guidance of your instructor) into groups of three or four. You will have 30 minutes to identify a method of obtaining $120.00 for the manufacturing exercise.

Your instructor will be looking for:

1. A solution that could also be used by a "real world" company.
2. A solution that is "workable" for your class.
3. A neat, well-written description of the solution.

INTRODUCTION TO MANUFACTURING
UNIT I-D

ASSIGNMENT SHEET #8 — IDENTIFY AN ORGANIZATIONAL STRUCTURE THAT IS APPROPRIATE FOR USE IN A CLASSROOM MANUFACTURING ACTIVITY

NAME ____ SCORE ____________

You are required to organize your class into a company that will produce and sell a product. In order for your company to function efficiently, an appropriate organizational structure must be identified.

Directions: Select one of the three structures discussed in the information sheet or a combination of two or more. In the space provided, sketch a chart that would permit your class to produce twenty or more of a small product.

Your instructor will be looking for:

1. Neat letters and lines.
2. The inclusion of the major company divisions.
3. A chart that is appropriate for the number of people in your class.

INTRODUCTION TO MANUFACTURING
UNIT I-D

NAME ______________________________ SCORE ________________________

TEST

1. Match the terms on the right with the correct definitions.

_____a. Products that last fewer than three years		1. Labor
_____b. Human activity or services performed by workers		2. Durable goods
		3. Nondurable goods
_____c. Organization that utilizes resources to produce goods and services to meet the wants and needs of individuals		4. Industry
		5. Services
_____d. Work performed to improve material goods or to benefit people		6. Natural resources

2. Complete the following statements concerning a historical perspective of manufacturing by placing the best answer in the appropriate blank.

_____a. The home handicraft system involved the production of most items

1) In the home, for use outside the home.
2) In the home, for use in the home.
3) Outside the home, for use in the home.

_____b. When items are produced in quantity at home to be sold by a merchant, this is called the ______________ system.

1) Bartering
2) Factory
3) Mercantile

_____c. The industrial revolution can be identified by which of the following key words?

1) Machines, homes
2) Machines, factories
3) Hand tools, homes
4) Hand tools, factories

TEST

3. Differentiate between production, manufacturing, and construction by placing the following letters next to the correct descriptions:

- P — Production
- M — Manufacturing
- C — Construction

_____a. Carried out at one site and used at another

_____b. Changing the form of materials to make them more usable

_____c. Carried out and utilized at the same site

4. Discuss the roles of transportation and communication in production.

a. Transportation — ____

____

b. Communication — ____

____

5. Categorize the following components of a manufacturing system according to the universal system model. Label each of the following as either inputs (I), processes (P), outputs (O), or feedback (F).

_____a. Management practices

_____b. Capital

_____c. Nondurable goods

_____d. Customer response

_____e. Finance

_____f. Human resources

_____g. Durable goods

_____h. Production practices

_____i. Natural resources

_____j. Personnel practices

TEST

6. Match the areas of a manufacturing organization on the right with the correct functions.

_____a. Obtaining and managing money

_____b. Concerned with selling the product

_____c. Identifies potential new products and processes

_____d. Actual making of the products

1. Production
2. Research and development
3. Industrial relations
4. Marketing
5. Financial affairs

7. Match the manufacturing divisions on the right with the correct job titles.

_____a. Training director

_____b. Design engineer

_____c. Public relations director

_____d. Salesperson

_____e. Graphic designer

_____f. Accountant

_____g. Foreman

1. Marketing
2. Financial affairs
3. Research and development
4. Production
5. Industrial relations

8. Discuss the relationship between management and organizational structure.

____

____

____

____

9. Distinguish between the types of organizational structures by placing the following letters next to the correct descriptions:

- L — Line organization
- L & S — Line and staff organization
- L & FS — Line and functional staff organization

_____a. Best suited for very large companies

_____b. Best suited for small companies

TEST

10. Discuss the purpose of each of the following general safety rules.

    a. Wear eye protection — ______________________

    b. Walk, do not run — ______________________

    c. Never throw objects — ______________________

    d. Keep lab area neat and orderly — ______________________

    e. Store flammable materials or caustic liquids in approved containers — ______________________

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

11. Participate in a mass production assembly operation. (Assignment Sheet #1)

12. Identify major movements that contributed to the Industrial Revolution. (Assignment Sheet #2)

13. Research and write about an inventor or invention that contributed to the Industrial Revolution. (Assignment Sheet #3)

14. Identify and gather information about two businesses in your community. (Assignment Sheet #4)

15. Describe societal needs that the manufacturing industry has addressed during the last two centuries. (Assignment Sheet #5)

16. Research a manufacturing technology career. (Assignment Sheet #6)

17. Demonstrate group problem solving skills during simulation activities in the laboratory. (Assignment Sheet #7)

18. Identify an organizational structure that is appropriate for use in a classroom manufacturing activity. (Assignment Sheet #8)

INTRODUCTION TO MANUFACTURING
UNIT I-D

ANSWERS TO TEST

1. a. 3
   b. 1
   c. 4
   d. 5

2. a. 2
   b. 3
   c. 2

3. a. M
   b. P
   c. C

4. Discussion should include:
   a. Transportation technology involves the movement of materials, people, and products to and from production sites as well as during the production process.
   b. Communication involves the movement of messages and information which are essential for any production. Without transportation and communication, production could not occur.

5. a. P
   b. I
   c. O
   d. F
   e. I
   f. I
   g. O
   h. P
   i. I
   j. P

6. a. 5
   b. 4
   c. 2
   d. 1

7. a. 5
   b. 3
   c. 5
   d. 1
   e. 1
   f. 2
   g. 4

8. The organization structure identifies the responsibilities of individuals within the organization.

9. a. L & FS
   b. L

10. Discussion evaluated to the satisfaction of the instructor

11.-18. Evaluated to the satisfaction of the instructor

MANUFACTURING SYSTEMS
UNIT II-D

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss the major manufacturing systems that are employed by industry. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to manufacturing systems with the correct definitions.
2. Distinguish between the types of manufacturing systems.
3. Select from a list the characteristics of a free enterprise system.
4. Match the items needed by a manufacturing enterprise with the correct descriptions.
5. State the function of management.
6. Identify the forms of ownership of manufacturing enterprises.
7. Complete statements concerning individual proprietorships.
8. Complete statements concerning general partnerships.
9. Select true statements concerning corporations.
10. Match types of corporations with the correct descriptions.
11. Complete statements concerning the importance of different forms of ownership in the United States.

OBJECTIVE SHEET

12. Complete statements describing legal requirements that affect free enterprise organizations.
13. Select characteristics of a license or permit.
14. List methods of obtaining capital resources.
15. Complete a blank stock certificate. (Assignment Sheet #1)
16. Sketch three views of a simple object. (Assignment Sheet #2)
17. Identify a product that can be manufactured by your class. (Assignment Sheet #3)

MANUFACTURING SYSTEMS
UNIT II-D

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

  1. Discuss and provide examples of how management orchestrates the resources needed in a manufacturing organization.
  2. Utilize the input-process-output model whenever a system or sub-system is discussed.
  3. Inform your students that they will be participating in a simulated mass production activity. A tic-tac-toe game is planned for production in this section.
  4. Use your available references to expand your presentation on three-view drawings.
  5. Finalize the organizational structure that will be used by the class to produce the product.
  6. Have each student identify a company listed on the New York Stock Exchange and follow it for 2 weeks. Students can then provide a report of "their" company.
  7. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Bame, E. A. and Paul Cummings. *Exploring Technology.* Worcester, MA.: Davis Publications, Inc., 1980.

B. Heiner, Carl W. and Wayne R. Hendrix. *People Create Technology.* Worcester, MA.: Davis Publications, Inc., 1980.

C. Lux, Donald and Willis Ray. *The World of Manufacturing.* Bloomington, IL: McKnight & McKnight.

D. Wright, R. Thomas and Richard M. Henak. *Exploring Production.* South Holland, IL: Goodheart-Willcox Co., Inc., 1985.

SUGGESTED SUPPLEMENTAL RESOURCES

Films

A. *Manufacturing Systems Explained,* #890

Bergwall Productions, Inc.
106 Charles Lindbergh Boulevard
Uniondale, NY 11553-3695
800-645-3565 (toll-free) or 516-222-1111 (in New York)

B. *Modern Corporations* (30 min.)

Sutherland Educational Films, Inc.
201 North Occidental Boulevard
Los Angeles, CA 90026

C. American Enterprise Series of 5 Films (color — each film 30 min.)
Government, Innovation, Land, Organization, People

Modern Talking Pictures Service
4705-F Bakers Ferry Road SW
Atlanta, GA 30336

MANUFACTURING SYSTEMS
UNIT II-D

INFORMATION SHEET

I. **Terms and definitions**

A. Capital — Money, buildings, machinery, and investments that are used, or available, to make products or services

B. Enterprise — A business organization

C. Entrepreneur — French word meaning "enterpriser"; a person who owns his or her own business

D. Free enterprise — Marketing-centered political/economic system which encourages as little government intervention and control as possible

E. Monopoly — Business which is the only producer of a good or service; one which has no competition

F. Profit — Economic reward for filling the needs and wants of consumers; return received by a business after all operating expenses have been paid

II. **Types of manufacturing systems** (Transparency 1)

A. Custom manufacturing

1. Oldest type of manufacturing.

2. Characterized by skilled craftsmen producing individual or limited quantity items.

3. Mechanized and/or automated production techniques are not used and the cost is very high.

Example: Handcarved front door for your home

B. Intermittent manufacturing

1. Used when the volume of products needed is too low for continuous manufacturing.

2. Products often produced in groups or lots.

3. Companies involved in this type of manufacturing are often called job shops since they contract or take orders for specific jobs or quantities.

Examples: Book printers, welding shops, machine shops, and other companies aimed at producing relatively short runs

INFORMATION SHEET

C. Continuous manufacturing

1. Used when large quantities of the product are needed.
2. Utilizes both automation and mechanization to reduce labor needs and hand operations.
3. Parts and components are necessary for continuous flow of the line.

   Example: Automobile factory

III. **Characteristics of a free enterprise system** (Transparency 2)

A. Freedom to enterprise

1. Individuals have the right to start, operate, and end their own businesses.
2. Individuals must accept risk when they open a business.
3. Individuals have the right to earn a profit and invest or spend it as they choose.

B. Ownership of property — Individuals have the right to own and sell their personal property.

C. Consumer choice — Individuals are free to choose which goods and services they wish to buy (and whether or not they wish to buy any at all).

D. Competition

1. Limits price that a business can effectively charge for its goods and services.
2. Encourages better quality merchandise and broader services within the businesses' operations.

   Examples: Convenient parking, use of credit, repair services, layaway
3. Encourages production of broader line of goods and services.

E. Supply and demand

1. Supply — Quantity of a product or service that producers are willing and able to make available for sale at a specific price and time.
2. Demand — Quantity of a product or service that consumers are willing and able to buy at a specific price and time.
3. Interaction of supply and demand determines what will be produced and what prices will be charged.

INFORMATION SHEET

4. Laws of supply and demand directly affect prices.

    a. As demand goes up and supply stays the same, prices go up.

    b. As demand goes down and supply stays the same, prices go down.

    c. As supply goes up and demand stays the same, prices go down.

    d. As supply goes down and demand stays the same, prices go up.

IV. **Items needed by a manufacturing enterprise** (Transparency 3)

(NOTE: Every manufacturing enterprise starts with an idea of a product which may be made for profit. The following five items are necessary to convert an idea into a profit-making organization.)

A. Finance — The money needed to start and maintain a manufacturing enterprise

B. Materials — All items used to manufacture a product

C. Management — People who plan, organize, direct, and control the manufacturing enterprise

D. Labor — People who perform the manufacturing operations

E. Facilities — All the physical things needed to convert the materials to a product; includes all utilities, energy resources, buildings, and equipment

V. **Function of management —** To plan, organize, direct, and control the other four resources. (Transparency 4)

(NOTE: Management plans the form and structure of the enterprise and makes sure the other resources work together to produce a **profit.**)

VI. **Forms of ownership of manufacturing enterprises** (Transparency 5)

A. Individual proprietorship — Has one owner

B. Partnership — Has two or more owners

C. Corporation — Has many owners, sometimes thousands.

Examples: American Telephone and Telegraph (AT&T), General Electric

INFORMATION SHEET

VII. **Characteristics of individual proprietorships**

A. Features of individual proprietorships

1. One person is the owner.
2. The single owner furnishes all the capital.
3. The owner collects the profits, or suffers the losses.
4. The owner makes the decisions.
5. The business is usually small.

B. Advantages of individual proprietorships

1. Easy to form and to dissolve.
2. Free from corporate taxes.
3. Free of many government controls.
4. All profits go to the owner.
5. One person makes all important decisions.
6. The owner is free to work the business hard or leisurely.
7. Financial records are private. No public disclosure of records must be made by the owner.

C. Disadvantages of individual proprietorships

1. Owner has unlimited liability — Even the owner's personal assets (home, car, etc.) can be repossessed to pay the debts of the business.
2. Can be unstable — The business may not run smoothly if the owner is absent frequently, is in poor health, or dies.
3. Possibility of expanding is limited — The single owner may not have sufficient capital to expand.
4. Expertise may be deficient — Few people understand well all aspects of successful business management.

(NOTE: Many small businesses are changed to corporations when they become too large or too complex to be run by an individual. The original owner may retain control (if not full ownership) by retaining more than 50% of the stock issued.)

INFORMATION SHEET

VIII. Characteristics of the general partnership

A. The general partnership is similar to the individual proprietorship. The chief difference is that the partnership has two or more owners.

B. The extent of ownership by the partners may vary which is usually determined in advance. The extent of ownership may be based on the percentage of total capital invested by each, or in the extent of the management responsibilities undertaken by each partner, or a combination of these.

(NOTE: For example, in the case of professional football teams there may be a managing general partner that owns 1/3 of the corporation and 6 or 7 other partners that own something less.)

C. Advantages of the general partnership

1. Easy to form and to dissolve.
2. Not liable for corporate taxes.
3. Free from many government controls.
4. Additional management expertise, especially if partners bring different talents to the business.
5. A sharing of business problems — One person does not have to do all the worrying.
6. Larger sums of money for capital investment

D. Disadvantages of the general partnership

1. Can be unstable — Absence, poor health, or death of any partner can hurt the business.
2. Has unlimited liability — Each partner's personal wealth may be repossessed to pay business debts.

   (NOTE: The extent of indebtedness of partners is not limited to the extent of each one's investment. Each partner is responsible for all debts of the business, regardless of the percentage of ownership.)

3. Has limited expansion potential, though not as limited as in the individual proprietorship.
4. Is subject to unresolvable disagreements between the partners.

   (NOTE: Even if arguments between partners are not related to business matters, they can seriously damage the health of the enterprise.)

INFORMATION SHEET

IX. Characteristics of a corporation

(NOTE: Most large manufacturing enterprises, and many small ones, are "incorporated.")

A. The corporation is considered a legal entity — A legal "being" having a life separate and distinct from the owners. Hence,

1. The liability of the owners is limited to the extent of their investment.

2. Individuals may invest in a corporation without risking their total personal fortunes.

   (NOTE: If you invest $100 in a corporation and the corporation fails, you lose only your investment. If a corporation goes bankrupt, all assets are sold and the money is distributed to the creditors. Any unpaid debts are written off and taken as a loss by the creditors.)

B. The vast majority of the owners of a corporation (shareholders) usually take little or no part in the management of the company.

C. Advantages of corporations

1. Limited liability for investors — Investors are not responsible for the debts of the company.

2. More stability — The corporation is not affected by the absence, ill health, or death of investors, or by the exchange of investments.

3. Unlimited capital — When money is needed for expansion, new stock issues provide the additional capital quickly.

D. Disadvantages of corporations

1. Are subject to corporate taxes and extensive government regulations.

2. Are more difficult to form and to dissolve because of certain government regulations which must be observed.

3. Investors are widely scattered; hence, they may take little interest in company management.

X. Types of corporations (Transparency 6)

A. Parent or holding corporation — A corporation that owns all or most of the stock of another corporation. Most subsidiary corporations produce products or services related to the parent corporation.

Example: General Motors subsidiaries produce car parts.

INFORMATION SHEET

B. Membership corporations — Do not issue stock. Most are non-profit organizations like the Red Cross, Salvation Army, churches, etc.

C. Municipal corporations — Cities, counties, and school districts that run the business of the community

XI. **Importance of different forms of ownership in the United States** (Transparency 7)

A. Corporations are by far the strongest force in our economy.

1. They account for over 75% of all products and services provided.

2. They employ over 80% of the work force.

B. Most businesses are individual proprietorships.

1. They account for more than 75% of all industrial firms.

2. This means that 3 out of every 4 businesses are owned by individuals even though more than 75% of all goods and services are provided by corporations.

XII. **Legal requirements that affect free enterprise organizations**

A. The American economic system is based on free enterprise.

1. This means that government avoids interfering in businesses except when necessary.

2. Some governmental control, however, is necessary in order to protect the consumer and other businesses from unfair trade practices.

B. Laws regulating business cover two areas.

1. The license, permit, or charter to operate.

2. The protection of people and the environment.

C. Laws regulating business originate at the local or state level. These vary a great deal from state to state and from locality to locality.

XIII. **Characteristics of a license or permit**

(NOTE: A license or permit is required for most individual proprietorships and partnerships.)

A. Is usually issued by the local or state government for a small fee.

B. Provides the local government with a record of the existence of the business.

C. Alerts government authorities to check the business for compliance with other laws.

INFORMATION SHEET

D. Contains information about the business.

  1. Type and location of the business
  2. Name of the owner or owners
  3. Permission to operate
  4. Issue date
  5. Expiration date
  6. Signature of authorized government official

XIV. Methods of obtaining capital resources

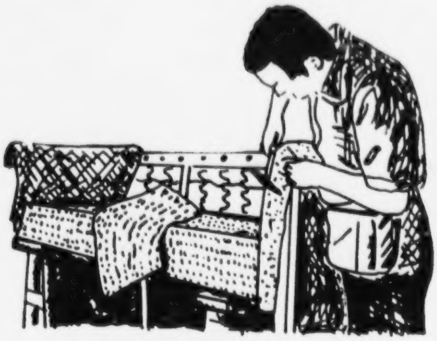
A. Individual proprietorships and partnerships obtain capital resources from:

  1. Private savings of the owners
  2. Loans from banks, finance companies, or friends
  3. A combination of savings and loans.

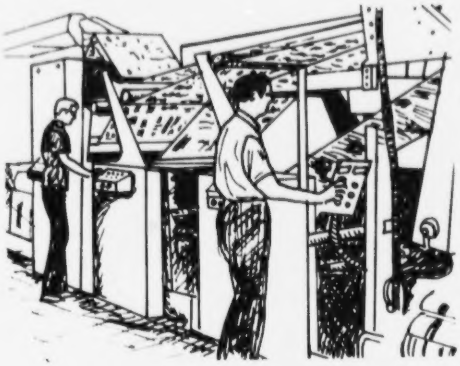
B. A corporation obtains capital resources by selling securities — stocks or bonds.

  1. Stocks — Are shares of ownership of a corporation. They earn money for the shareholder in the form of dividends (% of net profits).
  2. Bonds — Are certificates of public or private indebtedness. (You loaned the company money and they promise to pay you back.) They earn money for the bond owner in the form of interest.

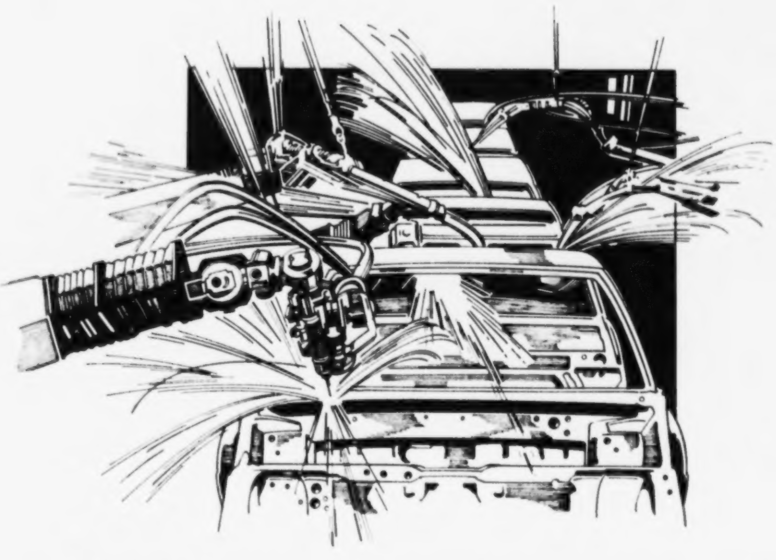
Types of Manufacturing Systems



Custom Manufacturing

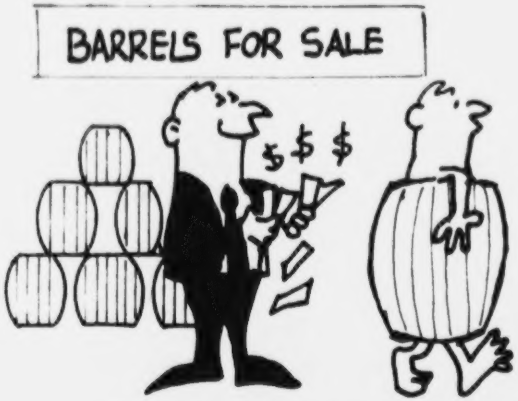


Intermittent Manufacturing

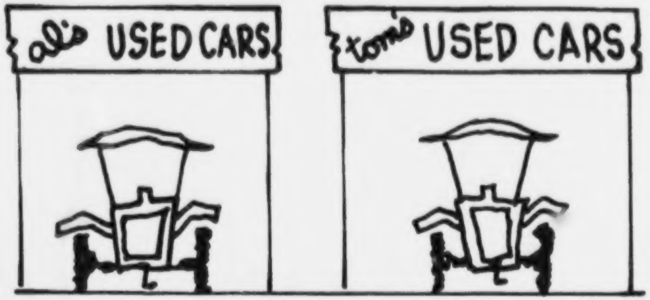


Continuous Manufacturing (Mass Production)

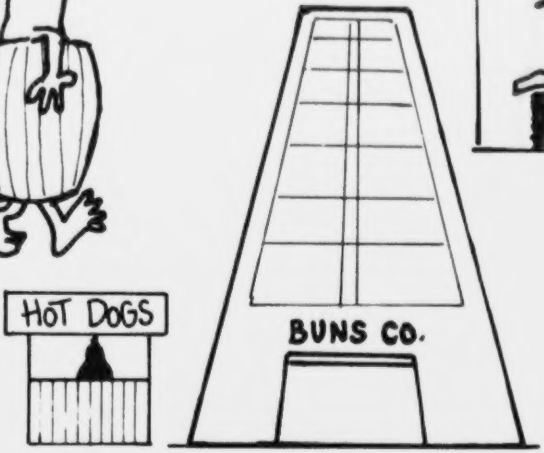
Characteristics of a Free Enterprise System


BARRELS FOR SALE
$ $ $

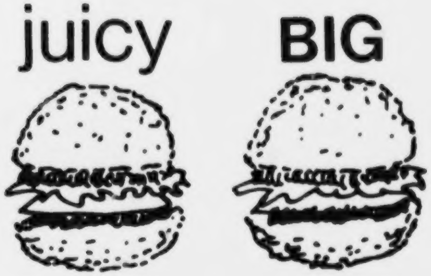
Supply & Demand


al's USED CARS
tom's USED CARS

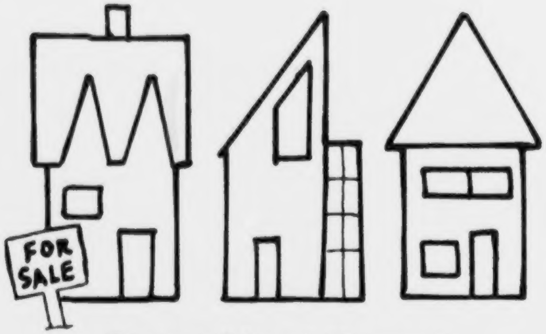
Competition


HOT DOGS
BUNS CO.

Freedom to Enterprise

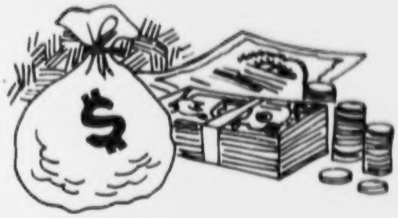


Consumer Choice

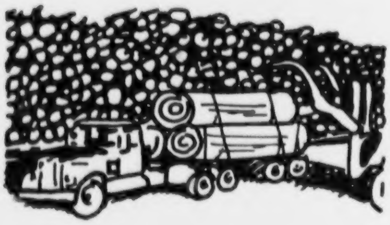


Ownership of Property

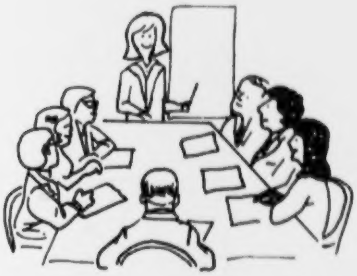
Items Needed by a Manufacturing Enterprise



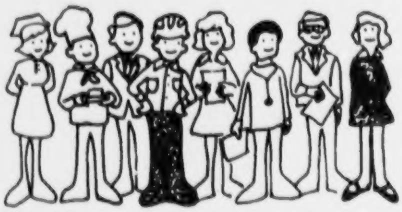
Finance



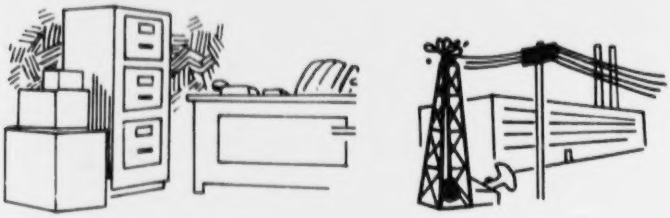
Materials



Management

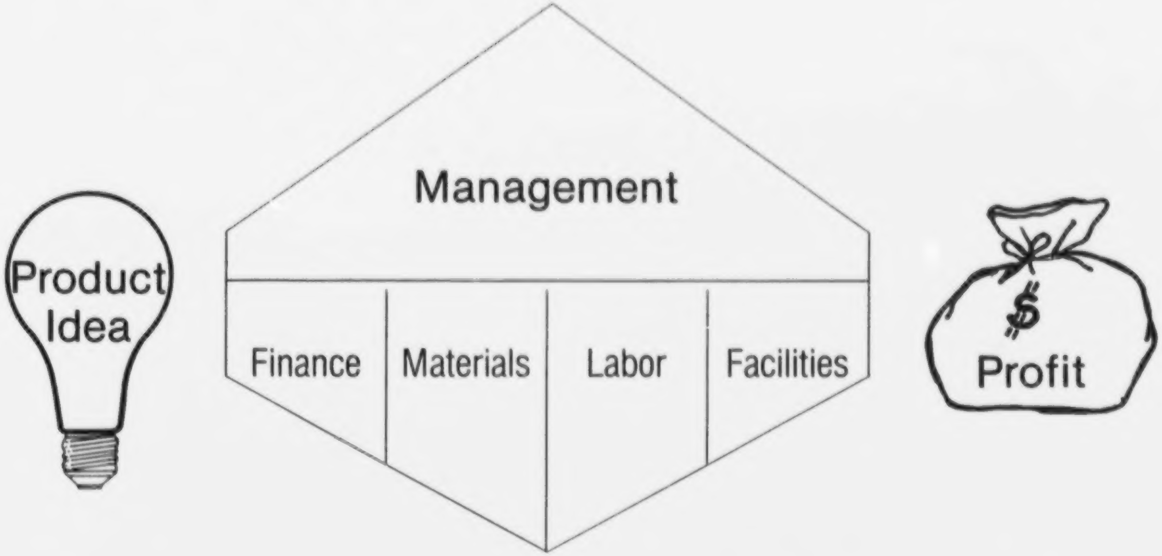


Labor



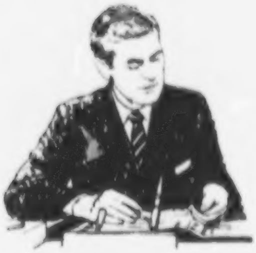
Facilities

Function of Management

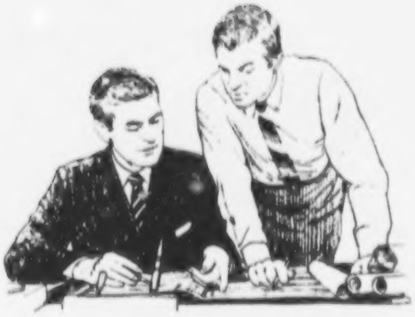

Product Idea
Management
Finance
Materials
Labor
Facilities
$
Profit

Management plans, organizes, directs, and controls the other four resources.

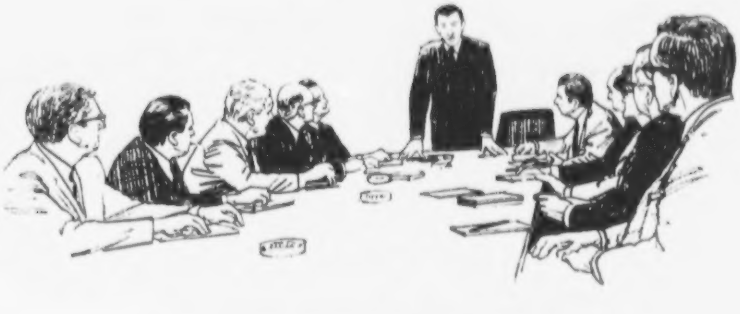
Forms of Ownership



Proprietorship

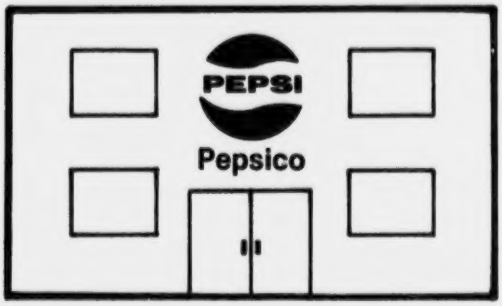


Partnership

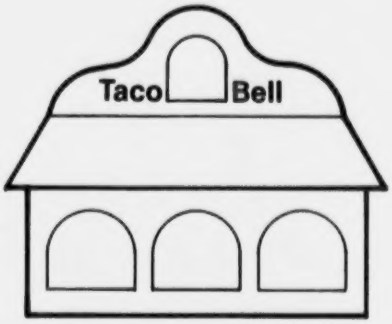


Corporation

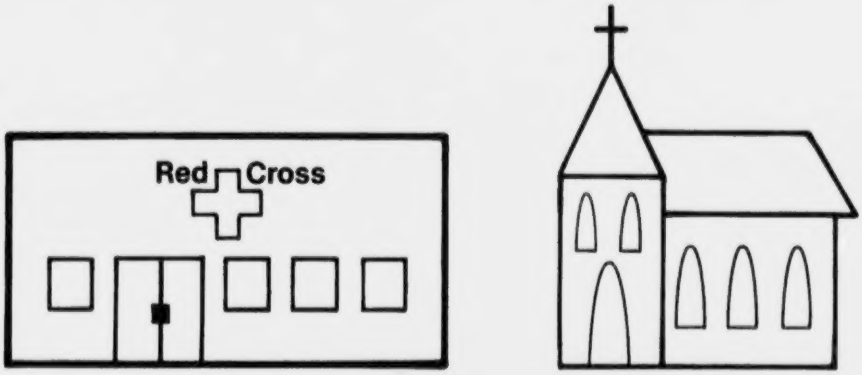
Types of Corporations


PEPSI
Pepsico

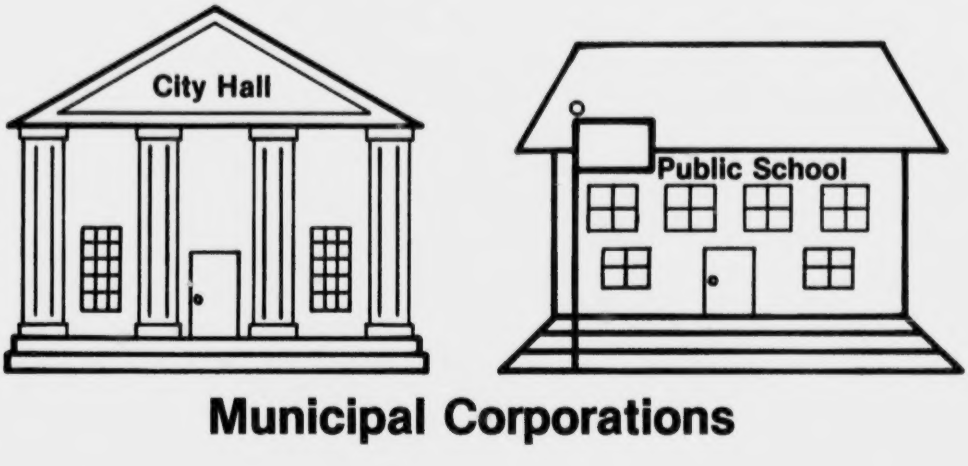
Parent Corporation



Subsidiary



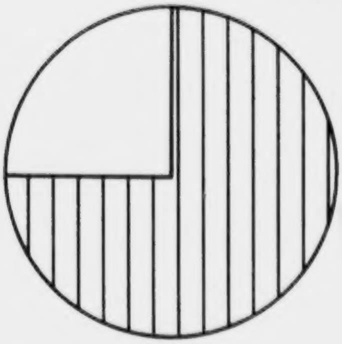
Membership Corporations


City Hall
Public School

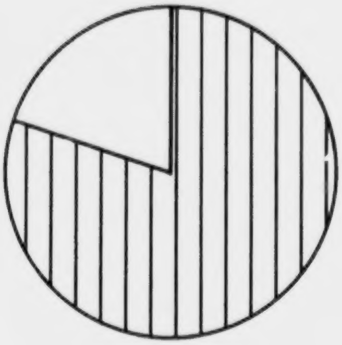
Municipal Corporations

Comparison of Ownerships

Corporations

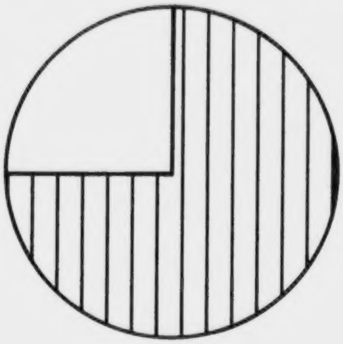


Produce 75% of all goods and services.



Employ 80% of the work force.

Individuals



Own 75% of all businesses.

MANUFACTURING SYSTEMS
UNIT II-D

ASSIGNMENT SHEET #1 — COMPLETE A BLANK STOCK CERTIFICATE

NAME ________________________________ SCORE __________

Given the following facts, fill out the blank stock certificate pictured below:

A. This is the 94th certificate issued by the Technical Manufacturing Company.

B. This is issued to you on April 11, 1986.

C. You purchase 50 shares.

D. The stock price is $42\frac{1}{2}$.

E. Jane Smith is president; Richard Doe is vice president; Jim Smith is secretary, and John Doe is treasurer.

NO. ____________ DATE ____________

________ SHARES VALUE ____________

TECHNICAL MANUFACTURING
COMPANY

____________________ ____________________

____________________ ____________________

MANUFACTURING SYSTEMS
UNIT II-D

ASSIGNMENT SHEET #2 — SKETCH THREE VIEWS OF A SIMPLE OBJECT

The purpose of this assignment sheet is to provide experience in sketching which will help in the identification and design of a product to be produced in your manufacturing class.

Instructions:

1. Identify any object inside a room at school or at home such as a desk, a table, a bookshelf, a file cabinet, a chair, etc.
2. Determine an appropriate scale as indicated by the information provided by your teacher.
3. Sketch three views of this object in the space provided below.
4. Your grade will be based on neatness and your ability to follow instruction and display proper sketching practices.

MANUFACTURING SYSTEMS
UNIT II-D

ASSIGNMENT SHEET #3 — IDENTIFY A PRODUCT THAT CAN BE MANUFACTURED BY YOUR CLASS

NAME ________________________________ SCORE __________

The purpose of this assignment sheet is to identify a possible product for use in the class mass production activity.

Directions:

1. Identify one product that would be appropriate for mass production in your laboratory.
2. Make certain that the following criteria are met:
    a. The cost of materials is not prohibitive.
    b. The manufacturing operations can be performed in the laboratory.
    c. The operations are not overly complex.
    d. The product is sellable.
    e. It is something that your classmates would be interested in producing.
3. Sketch the product in the space provided or on separate sheet.
4. Your instructor is looking for:
    a. Neatness
    b. Simple instructions
    c. Inexpensive materials

MANUFACTURING SYSTEMS
UNIT II-D

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

NO. 94

DATE April 11, 1986

50 SHARES

VALUE $42\frac{1}{2}$

TECHNICAL MANUFACTURING COMPANY

Richard Doe	Jane Smith
Vice President	President
John Doe	Jim Smith
Treasurer	Secretary

Assignment Sheets #2 and #3 — Evaluated to the satisfaction of the instructor

MANUFACTURING SYSTEMS
UNIT II-D

NAME ______________________________ SCORE ______________________

TEST

1. Match the terms on the right with their correct definitions.

______a. A person who owns his or her own business

______b. Business which is the only producer of a good or service; one which has no competition

______c. Economic reward for filling the needs and wants of consumers

1. Capital
2. Enterprise
3. Entrepreneur
4. Free enterprise
5. Monopoly
6. Profit

2. Distinguish between the types of manufacturing systems by placing the following letters next to the correct descriptions:

- CUSTOM — Custom manufacturing
- INT — Intermittent manufacturing
- CONT — Continuous manufacturing

______a. Companies involved in this are often called job shops since they contract or take orders for specific jobs or quantities

______a. Oldest type of manufacturing

______a. Utilizes both automation and mechanization

______a. Characterized by skilled craftsmen producing individual or limited quantity items

3. Select from the following list the correct characteristics of a free enterprise system by placing an "X" in the appropriate blanks.

______a. Supply and demand

______b. Competition

______c. Right to monopolize

______d. Consumer choice

______e. Ownership of property

______f. Freedom to enterprise

TEST

4. Match the items needed by a manufacturing enterprise listed on the right with the correct descriptions.

_____a. All the physical things needed to convert the materials to a product, includes all utilities, energy resources, buildings, and equipment

_____b. People who perform the manufacturing operations

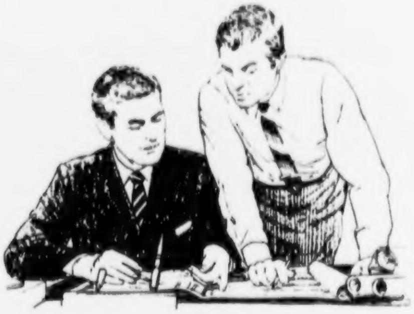
_____c. The money needed to start and maintain a manufacturing enterprise

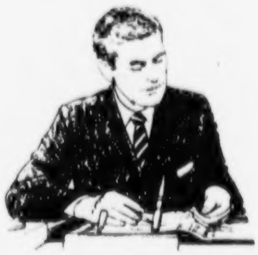
1. Materials
2. Facilities
3. Finance
4. Labor
5. Management

5. State the function of management. ____

____

6. Identify the following forms of ownership of manufacturing enterprises.





a. ______________________________ b. ______________________________

TEST

c. ________________________________

7. Complete the following statements concerning individual proprietorships by circling the best answers.
    a. In an individual proprietorship the business is usually (**small, large**).
    b. An individual proprietorship is (**easy, difficult**) to form and to dissolve.
    c. In an individual proprietorship all profits go to the (**stockholders, owner**).
    d. A disadvantage of the individual proprietorship is that the owner has unlimited (**assets, liability**).
8. Complete the following statements concerning general partnerships by circling the best answers.
    a. The general partnership (**is, is not**) liable for corporate taxes.
    b. Each partner (**is, is not**) responsible for business debts.
    c. The business has (**limited, unlimited**) expansion potential.
9. Select true statements concerning corporations by placing an "X" next to the true statements.

______a. When individuals invest in a corporation, all of their personal fortunes are liable for the corporation's debts.

______b. The majority of corporation shareholders take little part in the management of the company.

______c. Corporations usually have unlimited capital.

______d. Corporations are subject to corporate taxes.

______e. Corporations are easy to form and to dissolve.

TEST

10. Match types of corporations on the right with the correct descriptions.

_____a.	Owns all or most of the stock of another corporation	1. Municipal corporation
_____b.	Does not issue stock; includes the Red Cross and churches	2. Parent or holding corporation
_____c.	Cities, counties, and school districts that run the business of the community	3. Membership corporation

11. Complete the following statements concerning the importance of the different forms of ownership in the United States by circling the correct words.

    a. (**Individual proprietorship, Corporations**) account for over 75% of the products and services provided in the U.S.

    b. (**1, 2, 3**) out of every 4 businesses are individual proprietorships.

12. Complete the following statements concerning legal requirements that affect free enterprise organizations by filling in the blanks with the correct words.

    a. A free enterprise system means that ____________ avoids interfering in business except when necessary.

    b. Laws regulating businesses cover licensing and ____________ of people and the environment.

    c. ____________ vary a great deal from state to state.

13. Select from the following list the correct characteristics of a license or permit by placing an "X" in the appropriate blanks.

    _____a. Is usually issued by the federal government.

    _____b. Is usually issued by the local or state government.

    _____c. Provides the government with a record of the existence of the business.

    _____d. Contains information about the business such as owner name, issue date, location of business, and signature of authorized government official.

14. List three methods of obtaining capital resources.

    a. ____

    b. ____

    c. ____

TEST

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

15. Complete a blank stock certificate. (Assignment Sheet #1)

16. Sketch three views of a simple object. (Assignment Sheet #2)

17. Identify a product that can be manufactured by your class. (Assignment Sheet #3)

MANUFACTURING SYSTEMS
UNIT II-D

ANSWERS TO TEST

1. a. 3
   b. 5
   c. 6

2. a. INT
   b. CUSTOM
   c. CONT (or INT)
   d. CUSTOM

3. a, b, d, e, f

4. a. 2
   b. 4
   c. 3

5. To plan, organize, direct, and control the other four resources.

6. a. Partnership
   b. Individual proprietorship
   c. Corporation

7. a. Small
   b. Easy
   c. Owner
   d. Liability

8. a. Is not
   b. Is
   c. Limited

9. b, c, d

10. a. 2
    b. 3
    c. 1

11. a. Corporations
    b. 3

12. a. Government
    b. Protection
    c. Laws

13. b, c, d

14. a. Private savings
    b. Loans
    c. Selling securities — stocks or bonds

15.-17. Evaluated to the satisfaction of the instructor

MANUFACTURING MATERIALS AND EVALUATION
UNIT III-D

UNIT OBJECTIVE

After completion of this unit, the student should be able to exhibit a knowledge of the major manufacturing materials used by industry. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match common manufacturing materials with the correct descriptions.
2. Distinguish between the two major types of woods.
3. Select true statements concerning characteristics of woods.
4. Distinguish between the types of metals.
5. Match various types of metals with the correct characteristics.
6. Distinguish between the two major types of plastics.
7. Select from a list the properties of plastics.
8. List types of earth materials.
9. Select from a list the properties of earth materials.
10. Distinguish between types of composites.
11. Match general properties of materials with the correct descriptions.
12. Select true statements concerning considerations when selecting a material.
13. Test various properties of two samples of wood and record the results. (Assignment Sheet #1)
14. Justify the selection of materials for a simple product. (Assignment Sheet #2)

MANUFACTURING MATERIALS AND EVALUATION
UNIT III-D

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

  1. Obtain and display samples of materials as they are presented and discussed.
  2. Have each student make a verbal presentation supporting his or her choice of materials for a simple product. (Assignment Sheet #2)
  3. Select the "company" president from those students who have expressed an interest in the position. You may want to set up an "interview" with each candidate.
  4. Once the president has been selected, use the interview process to select the management teams. The job titles should be identical to the organizational structure identified in a previous unit.
  5. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Feirer, John F. *Woodworking for Industry.* Peoria, IL: Bennett, 1979.

B. *Industrial Education: Materials & Processes,* C.B.I.E. Project. Topeka, KS: Kansas State Department of Education, 1972.

C. *Iowa High School Curriculum — Manufacturing.* Des Moines: Iowa State University, The State Department of Education, 1986.

D. *Manufacturing.* Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc., 1977.

E. *Secondary Exploration of Technology.* Topeka, KS: Pittsburg State University, The State Department of Education, 1974.

F. Tracy, George R. *Modern Physical Science.* New York: Holt, Rinehart, and Winston, 1979.

G. Walker, John R. *Modern Metalworking.* South Holland, IL: Goodheart-Wilcox Co., 1976.

MANUFACTURING MATERIALS AND EVALUATION
UNIT III-D

INFORMATION SHEET

I. **Common manufacturing materials** (Transparency 1)

   A. Woods — Materials that are durable, have a medium hardness, poor electrical and heat conductors, lightweight, and come from trees

   B. Metals — Materials that have a high melting point, good conductivity, durable, medium to high hardness, and often are shiny

   C. Earth materials — Materials produced from minerals which are extracted from the earth's crust

   D. Plastics — Man-made materials that can easily be molded, cast, or drawn into objects or filaments; primarily made from petroleum products

   E. Composites — Materials that consist of two distinct solids bonded together

II. **Types of wood** (Transparency 2)

   A. Hard wood — Comes from deciduous (broadleaf) trees

   Examples: Oak, walnut, pecan, maple

   B. Soft wood — Comes from coniferous (needleleaf, cone bearing) trees

   Examples: Pine, fir, spruce

   (NOTE: This classification as hard or soft does not always indicate the degree of hardness of the wood. Some soft woods such as firs are harder than some hard woods such as fruit trees.)

III. **Characteristics of wood**

   A. Wood is relatively lightweight. This is explained by the fact that approximately half its volume is made of hollow cells. Wood has been referred to as an elastic honeycomb.

   B. Every piece of wood is different from every other although most wood is readily recognized as wood. This is because each piece comes from a living plant that differs from other plants and species or in growing conditions.

   C. Wood is graded in a number of ways.

      1. One can find wood that has very few knots, flaws, or defects, or one can find wood with many flaws.

INFORMATION SHEET

2. It is important for the manufacturer, if using wood, to select stock that meets the needs of that particular production project.

   (NOTE: Many of the machines found in industrial technology laboratories are made to work with wood.)

IV. Types of metals

A. Ferrous metals — Alloys which contain iron as a major element in their composition.

   Examples: Steel, iron

B. Nonferrous metals — Metals which contain no iron except in very small quantities as impurities.

   Examples: Aluminum, brass, tin, copper, lead, gold, silver

   (NOTE: Ferrous and nonferrous metals could also be classified as base metals containing only one metal or as alloys which have several metals fused or blended together.)

V. Characteristics of various metals

(NOTE: Metals have a wide variety of properties.)

A. Irons

   1. Pig iron — Hard and brittle due to the high carbon content and its impurities (silicon, sulfur, phosphorus, and manganese).

   2. Gray cast iron — Gets its name from the carbon that is in a free state in the form of graphite flakes throughout the crystalline grain structure of the metal.

   3. White cast iron — Has its carbon in a chemically combined state called cementite which makes it so hard it cannot be machined.

   4. Ductile cast iron — Made from gray cast iron by adding magnesium alloys to make the carbon form nodules in the soft iron.

   5. Malleable iron — White cast iron that is heated at high temperature for a long period of time to free its carbon into globules and make it soft and machinable.

   6. Wrought iron — Has virtually no carbon because it has been burned out in a puddling furnace

INFORMATION SHEET

B. Carbon steels

1. Low-carbon steel (.05-.30% carbon) — Also known as machine steel, machinery steel, and mild steel. Used for forge work, rivets, chains, and machine parts that do not need great strength.

2. Medium-carbon steel (.30-.60% carbon) — More difficult to bend, weld, and cut than low-carbon steel. Can be hardened and tempered by heat treatment. Used for bolts, shafts, car axles, rails, etc.

3. High-carbon steel (.60-1.50% carbon) — Also known as carbon tool steel. Can be hardened to make metal cutting tools.

C. Steel alloys

(NOTE: The following metals are added to steel to improve certain qualities.)

1. Nickel — Adds strength and toughness, shock and wear resistance, and rust resistance.

2. Chromium — Gives steel a lasting, bright, silvery gloss that does not corrode and improves hardness and toughness.

3. Manganese — Purifies, strengthens, and toughens the steel to make it withstand hard wear and strain.

4. Molybdenum — Adds strength and hardness to steel and helps it withstand heat and blows.

5. Tungsten — Produces a hard heat-resistant steel.

6. Vanadium — Gives lightness, toughness, and strength to steel.

D. Aluminum — Brilliant, silvery metal which is mined as bauxite. Weighs one-third as much as steel. Is a good conductor of heat and electricity.

E. Copper — Reddish-brown in color. Is an excellent conductor of electricity, second only to silver. Has high corrosion resistance, wear resistance, high temperature performance, and ductility.

F. Copper alloys

1. Brass — An alloy of copper and zinc which gives it a yellow color and keeps it from corroding as fast.

2. Bronze — An alloy of copper and tin which makes it harder and wear longer than brass.

3. German silver (also called nickel silver) — An alloy of copper, zinc, and nickel to substitute for silver in inexpensive jewelry.

G. Magnesium — Silver-white, light malleable metal much lighter than aluminum.

INFORMATION SHEET

H. Lead — Bluish-gray, heavy, poisonous metal.

I. Tin — Shiny, silver metal used mainly for coating steel or iron to protect against rust.

J. Zinc — Bluish white metal used mainly for coating steel or iron to protect against rust.

K. Gold — Precious, heavy, bright yellow metal used for ornamental work, jewelry, coins, and dental fillings.

L. Silver — Precious, shiny, white metal used for jewelry, tableware, mirrors, and coins. Best conductor of electricity.

(NOTE: The following two metals are called space age metals.)

M. Titanium — Strong as steel, but only half as heavy. Is bright, extremely corrosion resistant, withstands extreme temperatures, and can be machined easily.

N. Beryllium — Has a weight strength ratio similar to that of high strength steel or titanium but is 33 percent lighter than aluminum.

(NOTE: Beryllium was developed for highly specialized applications, but has evolved into use in products which have nuclear applications, and fabrication of lightweight aerospace structures.)

VI. **Types of plastics** (Transparency 3)

A. Thermoplastics — Are heated, shaped, and cooled, and can be reheated and reshaped again and again.

Examples: Acrylic, vinyl, polyethylene

B. Thermosetting — Are heated, shaped, and cooled, but *can not* be reheated or reshaped; are **set** by heat

Examples: Polyester, epoxy, silicone

VII. **Properties of plastics**

(NOTE: The properties of plastics vary greatly from family to family. A family of plastics is a group which is chemically the same.)

A. Low melting points

B. Flexible

C. Poor conductors (good insulators)

D. Durable

E. Medium hardness

F. Available in any color

INFORMATION SHEET

VIII. **Types of earth materials**

A. Bricks

B. Clay-based ceramics

Example: Ceramic tile, porcelain, china

C. Glass

D. Cement

IX. **Properties of earth materials**

A. Hard

B. Poor conductors (good insulators)

C. Heavy

D. Inflexible

E. High melting points

X. **Types and characteristics of composites** (Transparency 4)

A. Fiber composites — Fibers form a matrix to reinforce a material

Example: Fiberglass — Glass fibers reinforce plastic to make a very strong material

B. Particle composites — Particles are held in a matrix and both form a stronger unit

Examples: Particle board (wood chips and glue), concrete (cement, aggregate, and water)

C. Laminate composites — Layers are glued together

Examples: Plywood, laminated beams

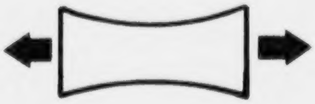
XI. **General properties of materials**

(NOTE: Materials useful for a specific manufacturing purpose need to have certain properties that fit that purpose.)

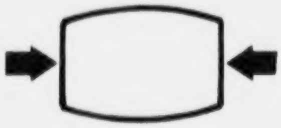
A. Hardness — Resistance to penetration or indentation

INFORMATION SHEET

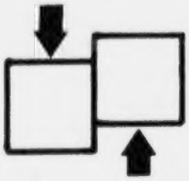
B. Tensile strength — Ability to withstand a pulling force



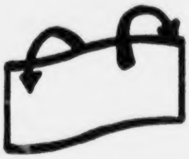
C. Compression strength — Ability to withstand crushing force



D. Shear strength — Ability to resist sliding of one surface over another



E. Torsion strength — Ability to withstand twisting force



F. Ductility — Ability to be bent, twisted, stretched, or changed in shape

G. Malleability — Ability to be hammered, rolled, or compressed into a different shape and remain as strong as its original shape

H. Thermal conductivity — Ability to conduct (carry) heat

I. Thermal expansion — Amount that material expands (enlarges) when subjected to heat or contracts when cooled

J. Chemical properties — Reactions or resistance to various chemicals (such as acids, water, oxygen)

K. Electrical conductivity — Ability to conduct (carry) electrical current

(NOTE: A material that readily conducts electricity is called a conductor. A material that will not conduct electricity is called an insulator.)

INFORMATION SHEET

XII. Considerations when selecting a material

A. The first step in the selection process is to determine the properties that are necessary for the material to be useful for a specific application. Some questions that the product designer may ask are:

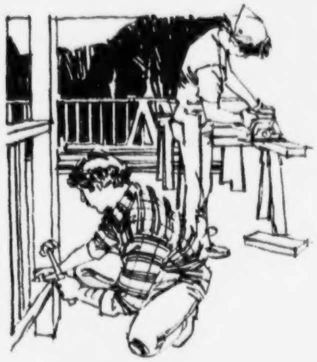
1. Will extreme temperature be likely?
2. Will the material be subjected to abrasive forces?
3. Will the material be exposed to solvents?
4. Will the material be subjected to heavy weights, impacts, or sharp objects?
5. Will the material come into contact with moisture?

B. Once these questions and others are answered, a material with the desired properties can be selected. Many times more than one material is suitable.

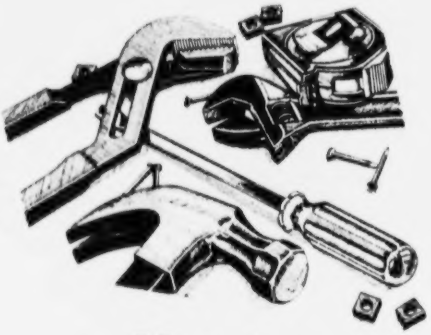
(NOTE: Occasionally materials must be made or created to meet a specific need such as many of the space [NASA] vehicle materials.)

C. Once the suitable material(s) have been identified, an analysis of the availability and cost must be made. This will allow the designer to select between several appropriate methods or terminate the project.

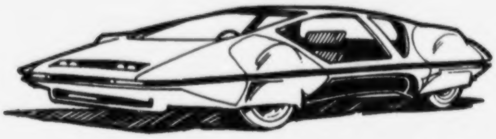
Common Manufacturing Materials



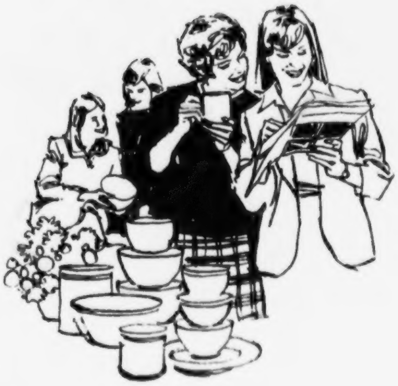
Woods



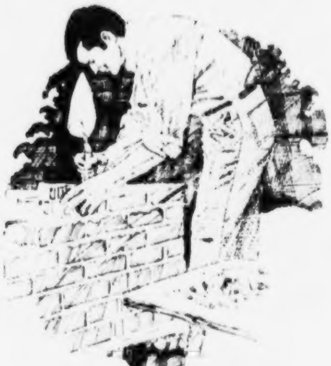
Metals



Composites

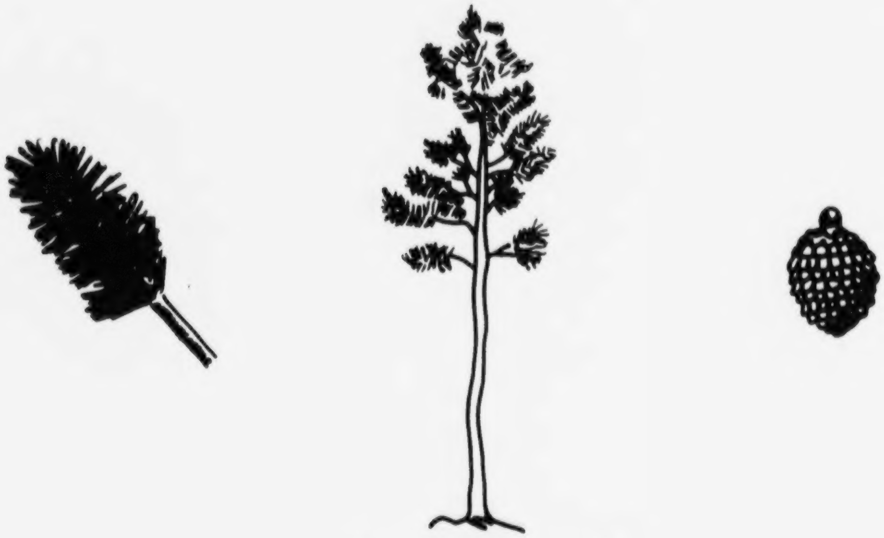


Plastics



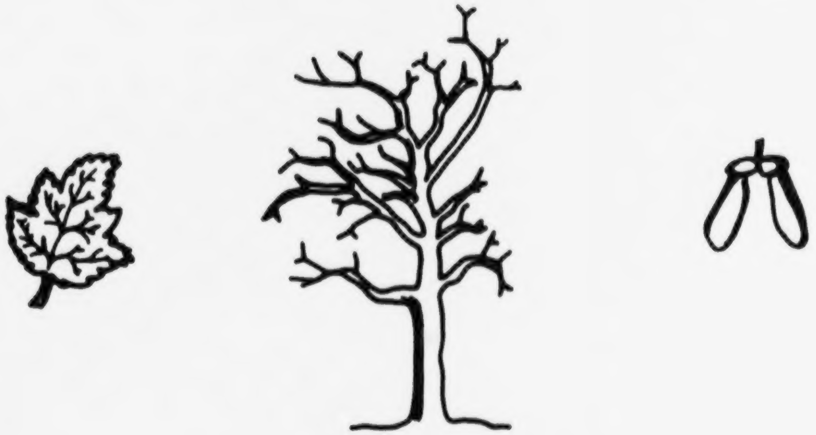
Earth Materials

Types of Wood



Soft Wood

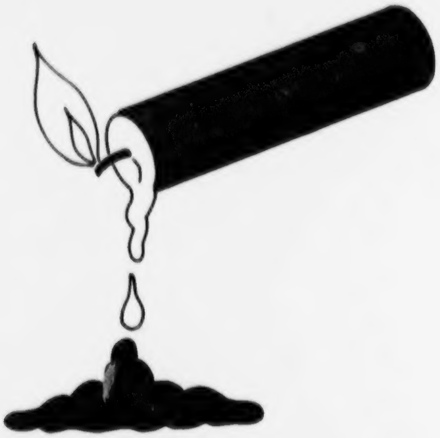
From Coniferous Trees



Hard Wood

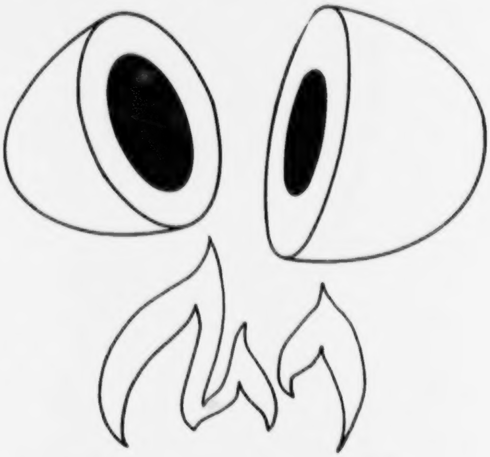
From Deciduous Trees

Types of Plastics



Thermoplastic

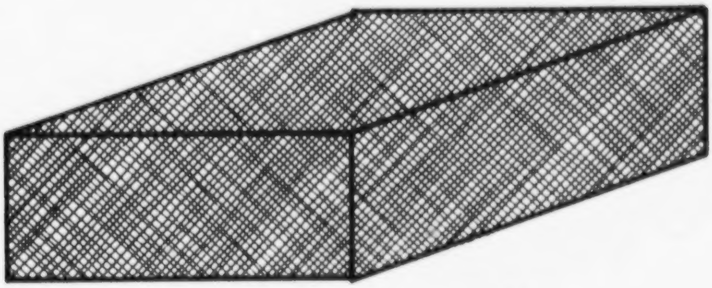
These plastics become soft when exposed to sufficient heat and harden when cooled. Process can be repeated.



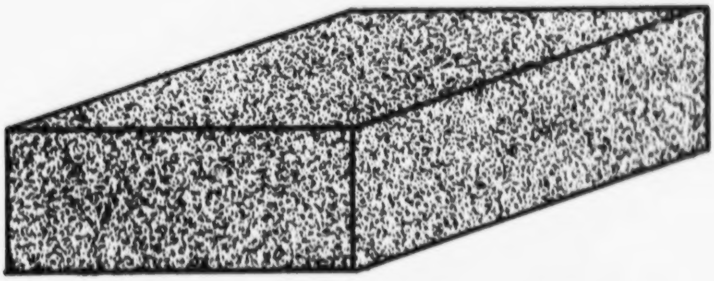
Thermosetting

These plastics become set into permanent shapes when heat and pressure are applied to them during the forming process. Reheating will not soften these materials.

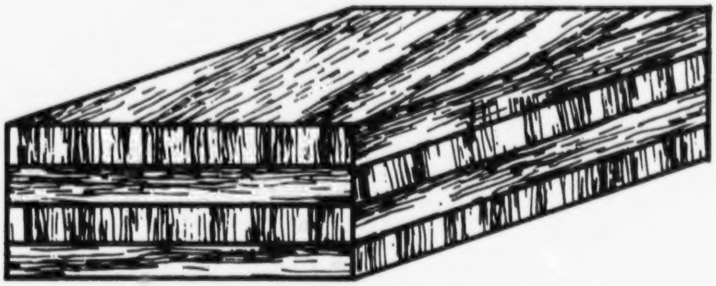
Types of Composites



Fiber Composite



Particle Composite



Laminate Composite

MANUFACTURING MATERIALS AND EVALUATION
UNIT III-D

ASSIGNMENT SHEET #1 — TEST VARIOUS PROPERTIES OF TWO SAMPLES OF WOOD AND RECORD THE RESULTS

NAME ______________________________ SCORE __________

You will be given two samples of wood. Once these have been obtained, follow the instructions for each of the following tests.

1. Use a brace and bit to drill holes in both samples. Which sample was easier to drill? __________
2. Use a wood rasp to file each sample. Which sample provided the best result? __________
3. Use a knife to carve small amounts of each sample. Which sample provided the best result? __________
4. Use a hammer to drive a small nail into both samples. Which sample was easier to nail? __________
5. What conclusions can you draw about Sample A and Sample B? Discuss below.

____

____

____

____

____

____

____

____

____

____

____

MANUFACTURING MATERIALS AND EVALUATION
UNIT III-D

ASSIGNMENT SHEET #2 — JUSTIFY THE SELECTION OF MATERIALS FOR A SIMPLE PRODUCT

NAME ____________________ SCORE ______________

Instructions: Identify a small product suitable for manufacturing such as a computer stand. Select the materials to be used for this product and justify your choice.

1. Product description (include a sketch).

2. Materials to be used.

	Part Name	Material
a.		
b.		
c.		
d.		
e.		

(NOTE: Give the reasons for your selections on the back of this page.)

ASSIGNMENT SHEET #2

3. Reason for selection of each material.

MANUFACTURING MATERIALS AND EVALUATION
UNIT III-D

NAME ______________________________ SCORE ______________________

TEST

1. Match the common manufacturing materials on the right with the correct descriptions.

_____a. Man-made materials that can easily be molded, cast, or drawn into objects or filaments; primarily made from petroleum products

_____b. Materials that have a high melting point, good conductivity, durable, medium to high hardness, and often are shiny

_____c. Materials that consist of two distinct solids bonded together

_____d. Materials produced from minerals which are extracted from the earth's crust

_____e. Materials that are durable, have a medium hardness, poor electrical and heat conductors, lightweight, and come from trees

1. Woods
2. Metals
3. Plastics
4. Earth materials
5. Composites

2. Distinguish between the two major types of wood by placing the following letters next to the correct descriptions:

- H — Hard wood
- S — Soft wood

_____a. Comes from coniferous trees.

_____b. Comes from deciduous trees.

3. Select true statements concerning characteristics of wood by placing an "X" next to the true statements.

_____a. Wood is relatively lightweight.

_____b. Every piece of wood is the same.

_____c. Wood is graded by its density.

TEST

4. Distinguish between the types of metals by placing an "X" next to the description of **ferrous** metals.

_____a. Metals which contain no iron

_____b. Alloys which contain iron as a major element in their composition

5. Match various types of metals on the right with the correct characteristics.

_____a. Also known as carbon tool steel. Can be hardened to make metal cutting tools.

_____b. Brilliant, silvery metal which is mined as bauxite. Is a good conductor of heat and electricity.

_____c. Reddish-brown in color; an excellent conductor of electricity

_____d. An alloy of copper and zinc which gives it a yellow color

_____e. An alloy of copper, zinc, and nickel to substitute for silver in inexpensive jewelry

_____f. Bluish-gray, heavy, poisonous metal

_____g. Shiny, silver metal that is used mainly for coating steel or iron to protect against rust

_____h. Precious, heavy, bright yellow metal used for jewelry and coins

_____i. Precious, shiny, white metal used for jewelry and coins; best conductor of electricity

1. Aluminum
2. Brass
3. Bronze
4. Copper
5. German silver
6. Gold
7. High carbon steel
8. Iron
9. Lead
10. Low carbon steel
11. Magnesium
12. Medium carbon steel
13. Silver
14. Tin

6. Distinguish between the two types of plastics by placing a "TP" next to the description of thermoplastics and a "TS" next to the description of thermosetting plastics.

_____a. Can **not** be reheated and reshaped

_____b. Can be reheated and reshaped

TEST

7. Select from the following list the correct properties of plastics by placing an "X" in the appropriate blanks.

_____a. Durable

_____b. Delicate

_____c. Good conductors

_____d. High melting points

_____e. Low melting points

_____f. Poor conductors

_____g. Flexible

_____h. Inflexible

8. List three types of earth materials.

a. ____

b. ____

c. ____

9. Select from the following list the correct properties of earth materials by placing an "X" in the appropriate blanks.

_____a. Good conductors

_____b. Poor conductors

_____c. High melting points

_____d. Low melting points

_____e. Hard

_____f. Soft

_____g. Flexible

_____h. Inflexible

TEST

10. Distinguish between the types of composites by placing the following letters in the appropriate blanks.

- F — Fiber composites
- P — Particle composites
- L — Laminate composites

_____a. An example is plywood.

_____b. An example is fiberglass.

_____c. An example is concrete.

11. Match general properties of materials on the right with the correct descriptions.

_____a. Ability to resist sliding of one surface over another

_____b. Ability to withstand crushing force

_____c. Ability to carry heat

_____d. Resistance to penetration or indentation

_____e. Ability to withstand a pulling force

_____f. Ability to be bent, twisted, stretched, or changed in shape

_____g. Ability to be hammered, rolled, or compressed into a different shape and remain as strong as its original shape

1. Hardness
2. Tensile strength
3. Compression strength
4. Shear strength
5. Torsion strength
6. Ductility
7. Malleability
8. Thermal conductivity
9. Thermal expansion
10. Chemical properties
11. Electrical conductivity

TEST

12. Select true statements concerning considerations when selecting a material by placing an "X" next to the true statements.

    _____a. The first step in the selection process is to determine the properties that are necessary for the material to be useful for a specific application.

    _____b. The first step in the selection process should be to determine cost.

    _____c. Many times, more than one material is suitable.

    _____d. Once suitable material(s) have been identified, an analysis of the availability and cost must be done.

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

13. Test various properties of two samples of wood and record the results. (Assignment Sheet #1)

14. Justify the selection of materials for a simple product. (Assignment Sheet #2)

MANUFACTURING MATERIALS AND EVALUATION
UNIT III-D

ANSWERS TO TEST

1. a. 3
   b. 2
   c. 5
   d. 4
   e. 1

2. a. S
   b. H

3. a

4. b

5. a. 7
   b. 1
   c. 4
   d. 2
   e. 5
   f. 9
   g. 14
   h. 6
   i. 13

6. a. TS
   b. TP

7. a, e, f, g

8. Any three of the following:
   a. Bricks
   b. Clay-based ceramics
   c. Glass
   d. Cement

9. b, c, e, h

10. a. L
    b. F
    c. P

11. a. 4
    b. 3
    c. 8
    d. 1
    e. 2
    f. 6
    g. 7

12. a, c, d

13.-14. Evaluated to the satisfaction of the instructor

MANUFACTURING PROCESSES
UNIT IV-D

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify and explain the major types of manufacturing processes. Competencies will be demonstrated by completing the assignment sheets, job sheets, and unit tests with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Classify operations as pre-processing, processing, or post-processing.
2. Distinguish between primary and secondary manufacturing processes.
3. Distinguish between the major types of separating processes.
4. Select from a list the elements of the forming process.
5. Arrange in order the steps in the casting process.
6. Distinguish between the types of conditioning processes.
7. Complete statements concerning assembly processes.
8. Distinguish between the major finishing operations.
9. Complete statements concerning the three major types of maintenance.
10. Select true statements concerning general safety rules.
11. Identify tools and machines in your laboratory that are used for separating. (Assignment Sheet #1)

OBJECTIVE SHEET

12. Measure distances using both English and metric scales. (Assignment Sheet #2)
13. Identify the subassemblies that make up a small hand or power tool. (Assignment Sheet #3)
14. Modify a basic design for mass production. (Assignment Sheet #4)
15. Demonstrate the ability to:
    a. Operate the scroll saw to make curved cuts. (Job Sheet #1)
    b. Operate the drill press to cut holes in acrylic stock. (Job Sheet #2)

MANUFACTURING PROCESSES
UNIT IV-D

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Provide students with job sheets.

H. Discuss and demonstrate the procedures outlined in the job sheets.

I. Integrate the following activities throughout the teaching of this unit:

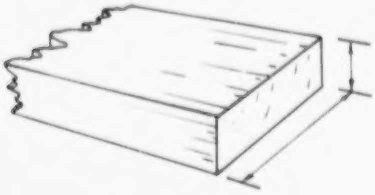
1. Take a field trip to a local manufacturing company to allow students to view a manufacturing organization at work.

2. Have students discuss conditioning operations that are performed in or around the home.

   Examples: Tilling soil, watering plants, baking cakes, adding fabric softener to clothes, etc.

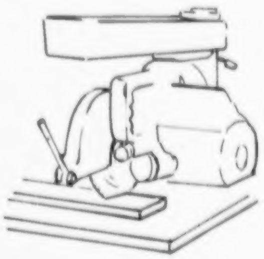
3. Use the following series of steps (or a variation) to produce a teacher-made prototype of the tic-tac-toe game. (Handout #1 lists measurements.)

   a. Surface stock to size with a planer.



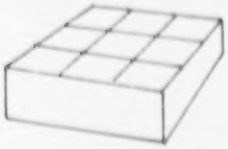
(NOTE: Shelving stock may eliminate this step.)

   b. Cut to length with a radial arm saw.

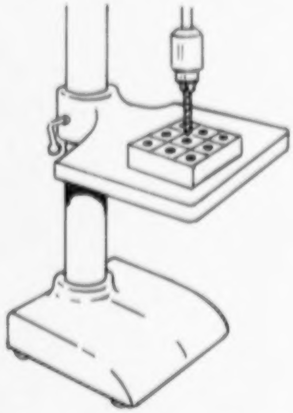


SUGGESTED ACTIVITIES

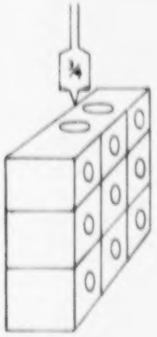
c. Cut dados and grooves with table saw. You may want to cut to final size also. Cross-cut first, then rip.



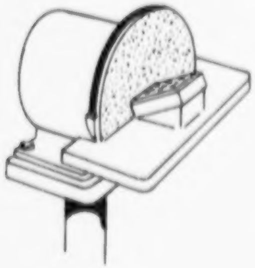
d. Drill marble holes with twist drill.



e. Bore holes for marble storage with spade drill.



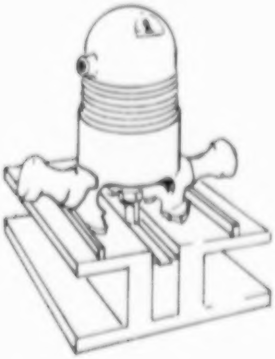
f. Bevel edges of wooden block with disk sander.



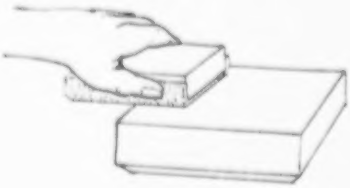
SUGGESTED ACTIVITIES

One solution to the marble storage involves the following: (You may prefer to use a solution produced by students in Assignment Sheet #4.)

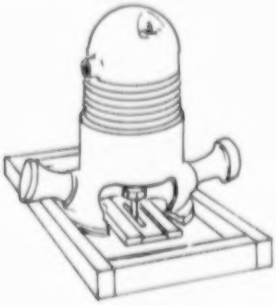
g. Cut groove in edge with router (over holes).



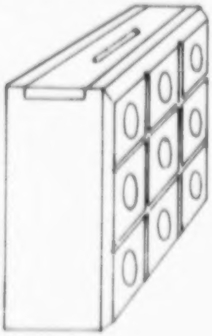
h. Sand wooden block with orbital sander. Hand sand and apply oil finish to wooden block.



i. Shear plastic slide to size with squaring shears ($^{1}/_{16}$" plastic laminate). Cut slot in plastics slide with router.



j. Finish the slide edges with a disc sander. Assemble slide to wooden block with an ornamental wood screw.



k. Inspect manufacturing quality. Load two sets of marbles.

4. Have the Research and Development division identified by the class prepare a systematic approach to producing the product. This should include a sequenced series of operations with various tools and machines. (Handout #2)

5. Have the Finance and Accounting section of the enterprise activity prepare stock certificates and identify the number and value of these certificates. The sale of these certificates will finance the activity.

6. Suppliers of marbles, wood stock, and other items should be identified and orders placed to prepare for the production in the next unit.

SUGGESTED ACTIVITIES

7. The production supervisor should begin to identify production jobs and prepare forms for job interviews.

8. Discuss all machines and tools to be used in this unit. Demonstrate their correct uses and safety considerations.

9. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

J. Give test.

K. Evaluate test.

L. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Feirer, John F. *Woodworking for Industry.* Peoria, IL: Bennett, 1979.

B. *Industrial Education: Materials and Processes,* C.B.I.E. Project. Topeka: Kansas State Department of Education, 1972.

C. *Iowa High School Curriculum — Manufacturing.* Des Moines: Iowa State University, State Department of Education, 1986.

D. *Manufacturing.* Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc., 1977.

E. *New Jersey Industrial Arts Education Safety Guide.* Rutgers University, 1983.

F. *Manufacturing Technology: Teacher's Handbook.* John W. Sinn, Bismarck, ND: North Dakota State Board for Vocational Education, 1983.

G. *Secondary Exploration of Technology.* Topeka: Kansas State College of Pittsburg, State Department of Education, 1974.

H. Walker, John R. *Modern Metalworking.* South Holland, IL: Goodheart-Wilcox Co., 1976.

I. Wright, R. Thomas and Richard M. Henak. *Exploring Production.* South Holland, IL: Goodheart-Wilcox Co., 1985.

SUGGESTED SUPPLEMENTAL RESOURCES

Films

A. *Basic Elements of Production* (13 min.)
University of Michigan
Audio-Visual Education Center
Ann Arbor, MI 48106

SUGGESTED ACTIVITIES

B. *Conserving a Heritage* (16 min.)
Wisconsin Petroleum Council
25 West Main Street
Madison, WI 53703

C. *Factory: How a Product is Made* (14 min.)
University of Michigan
Audio-Visual Education Center
Ann Arbor, MI 48106

D. *Functions of Industry and You*
University of Illinois
Visual Aids Service
Champaign, IL 61820

E. *For Beauty and Use* (13 min.)
National Association of Manufacturers
227 Park Avenue
New York, NY 10017

MANUFACTURING PROCESSES
UNIT IV-D

INFORMATION SHEET

(NOTE: In early history people used materials as they were found in nature. They did not know how to change natural materials in ways that would make them more useful or easier to use. The task employed to change the form of materials to make them more useful is called processing.)

I. **Operations in processing technology** (Transparency 1)

   A. Pre-processing

      1. All the operations that must be done to a material before it is processed

      2. Includes locating, harvesting, drilling, extracting, storing, and transporting

   B. Processing

      1. Takes place in a plant at some time such as oil refineries, lumber mills, food processing plants, and paper manufacturing plants

      2. Includes both primary and secondary manufacturing processes

   C. Post-processing

      1. Refers to what is done to the material after it has been processed

      2. Includes storing, transporting, and distributing

II. **Primary and secondary manufacturing processes** (Transparencies 2-5)

   A. Primary processes — Operations by which natural resources (coal, trees, metal ore, sand, clay, etc.) are converted to products that manufacturing plants can use. (Transparency 2)

      1. Metal ores are mined and then melted so the metals can be separated from the impurities.

      2. Chemical elements are combined to form various plastics.

      3. Petroleum is refined to produce products such as gasoline, fuel gas, oil, and asphalt.

      4. Trees are cut down, stripped, and cut to boards that can be used by builders.

      5. Animals are slaughtered and butchered into sides or quarters to be used by the meat packing industry.

INFORMATION SHEET

B. Secondary processes — Operations that use the industrial materials produced by primary production processes to make finished products. There are seven basic secondary processes. (Transparencies 3-5)

1. Separating — Removing excess material to produce a desired size, shape, or finish

2. Forming — Changing the size and shape of a material, but not the volume

3. Casting — Pouring or forcing a material in liquid form into a mold and allowing it to harden before removal

4. Conditioning — Changing the internal structure of industrial materials to give them desired properties so they can be better used

   Examples: Baking dough to make bread, firing ceramic clay to make vases

5. Assembling — When parts are brought together so that they stay together for a definite period of time

6. Finishing — Any operation or treatment done to protect or decorate a finished product

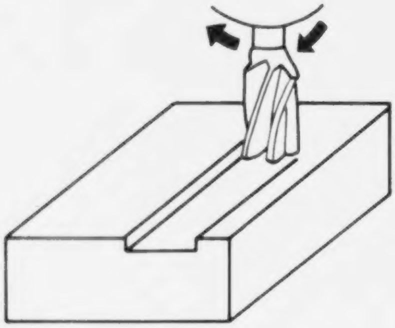
7. Servicing (maintenance) — All activities necessary to keep a product functioning properly or to get it to resume functioning after it has failed

III. Major types of separating processes

A. Machining — Changing size and shape by removing excess material by chips

Examples: Planing, drilling, routing, grinding, sawing

FIGURE 1

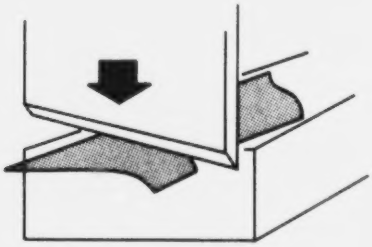


INFORMATION SHEET

B. Shearing — Using opposing edges to fracture (break) the excess material away

Example: Shearing tool or machine

FIGURE 2



(NOTE: More separating processes are performed by machining than by shearing. Can you name which tools and machines in your laboratory are used for machining and which for shearing?)

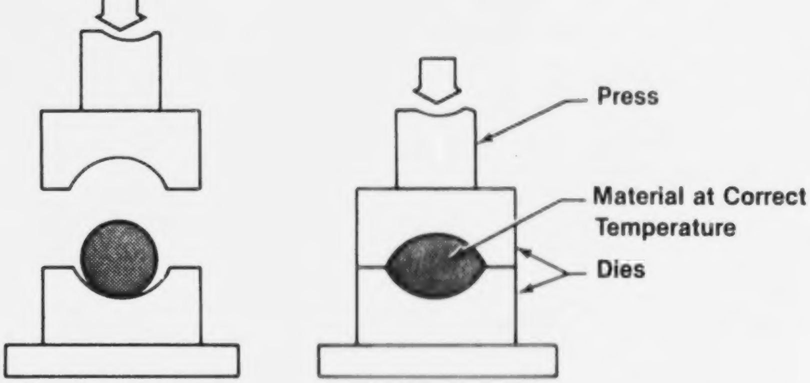
IV. **Elements of the forming process**

A. Forming devices — Dies and rolls that determine the final shape of the product

B. Forming temperature of material — Correct degree of heat or cold to form the material without causing internal stress

C. Method for applying force — Using hammers, presses, draw benches, or rollers to force the material against the forming devices

FIGURE 3



INFORMATION SHEET

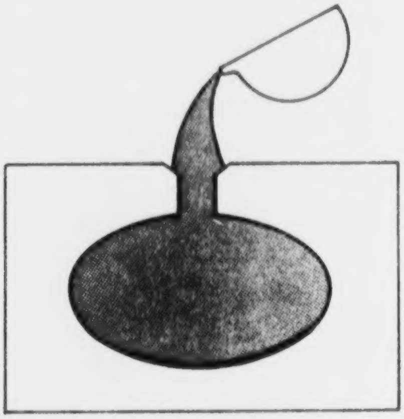
V. Steps in the casting process

A. A mold of the proper shape is produced. These may be one-shot molds or permanent molds for repeated use.

B. The material is prepared for casting. Material must be liquid or semiliquid.

C. Material is poured or forced under pressure into the mold.

FIGURE 4



Examples: Gravity poured — Sand mold, slip casting mold

Forced — Die casting metals, injection molding plastics

D. Material is allowed or forced to harden (solidify).

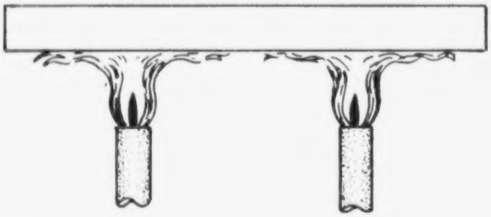
E. The finished item is removed from the mold.

INFORMATION SHEET

VI. Types of conditioning processes

A. Thermal conditioning — Using heat to improve the physical or mechanical properties of a material

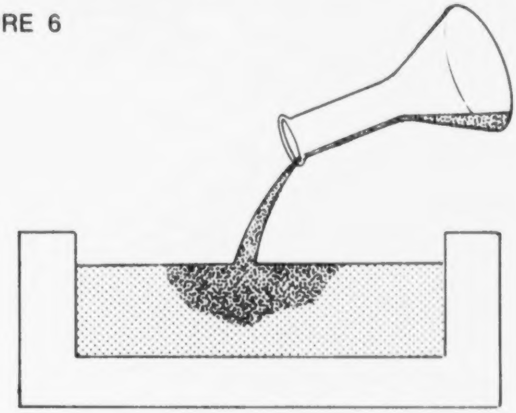
FIGURE 5



Examples: Drying (seasoning) wood
Heat-treating metal (hardening, tempering, annealing)
Firing ceramics

B. Chemical conditioning — Adding a chemical to improve the physical or mechanical properties of a material

FIGURE 6

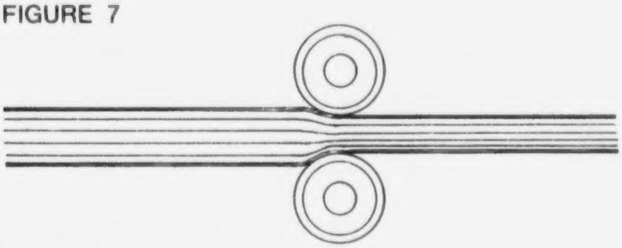


Examples: Adding yeast to bread dough to make it softer, adding manganese to molten steel to make it stronger

INFORMATION SHEET

C. Mechanical conditioning — Using pounding or squeezing action to change the internal structure and thereby improve the physical or mechanical properties of a material

FIGURE 7



Examples: Pounding steak to break the tough connecting fibers and make it more tender, compressing wood to make it take up less space and still be strong

VII. **Assembly processes** (Transparencies 6 and 7)

A. Any product made up of more than one part is called an assembly. Not only are solid parts assembled, but also the mixing of liquids and gases constitute assembly.

B. A subassembly is an assembly that will be combined with other assemblies to make a product.

C. A final assembly is a finished product that goes to a customer.

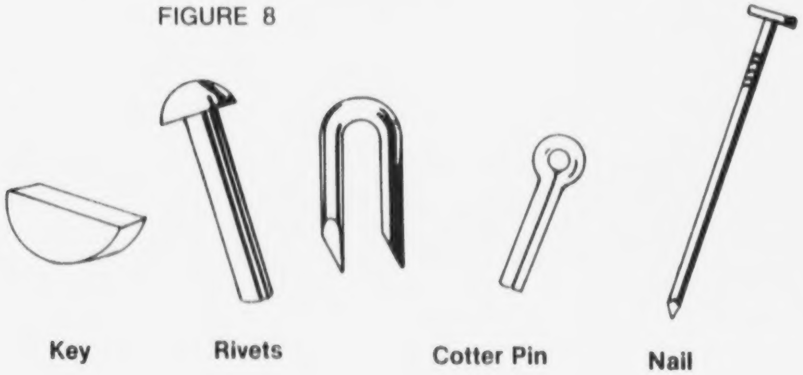
D. Assembly operations may be fastened with several systems depending on whether they should be temporary or permanent.

1. Mechanical fasteners

(NOTE: Mechanical fasteners are perhaps the most frequently used method of fastening materials.)

a. Nonthreaded fasteners

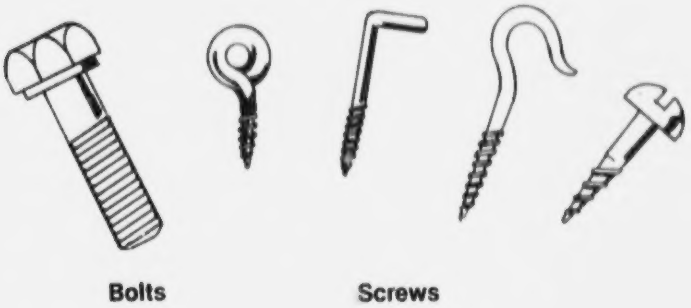
FIGURE 8



INFORMATION SHEET

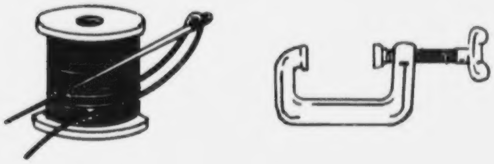
b. Threaded fasteners

FIGURE 9



c. Miscellaneous fasteners

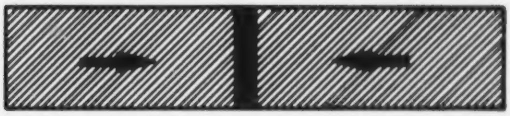
FIGURE 10



1) Sewing
2) Weaving
3) Pressing (clamping)
4) Pinning
5) Clipping

2. Adhesives

FIGURE 11



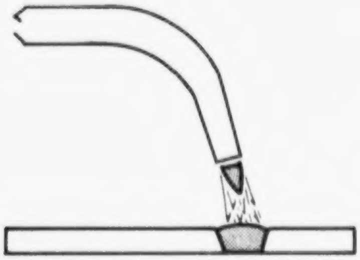
a. Cements

b. Glues

INFORMATION SHEET

3. Welding

FIGURE 12



VIII. Major finishing operations

A. Cleaning — Using brushes or chemicals to remove deposits of grease, dust, rust, or other impurities on the surface of the product.

B. Treating — Includes a number of finishing operations whose purpose is to prepare the surface for a coating process.

C. Coating or plating — Includes all those processes by which a protective or decorative material is added to the surface.

Examples: Plating with copper or gold, painting, plasticizing, lacquering, zinc coating

IX. Major types of maintenance

A. Preventive maintenance — Planned lubrication, adjustment, cleaning, and tuning operations which are done to prevent more serious unexpected problems.

B. Minor maintenance — All the somewhat expected replacement or repair operations which are fairly easy to do and can be done rather quickly.

C. Major maintenance — Extensive replacement or repair; includes such operations as complete overhaul or complete reconditioning.

X. General safety rules

(NOTE: Since power equipment will be used in this phase of your class, it is important that you follow each of the following rules.)

A. Obtain instructor's approval before operating any power equipment.

B. Always wear proper eye protection devices.

C. Remove jewelry and confine loose clothing and long hair.

D. Never operate a machine if over-tired or ill.

INFORMATION SHEET

E. Operations should be thought through before being performed.

F. Make all the necessary adjustments before turning on the power.

G. Make sure all guards are in place and functioning properly.

H. Allow the machine to reach its full operating speed before starting to feed the work.

I. Only approved push sticks, push blocks, and feather-boards should be used.

J. Keep machine tables and working surfaces clear of tools, stock, and other project materials.

K. Feed the stock carefully and only as fast as the machine will accept it easily.

L. Hands should be kept a minimum distance of 4" from the cutting tool.

M. If a machine is not working properly, the instructor should be informed immediately.

N. The operator should not allow his/her attention to be distracted while using a machine.

O. Avoid "walking through" or "crowding around" areas where machines are being operated by other students.

P. Machines should never be left running while unattended.

Q. Machines should not be used for trivial operations.

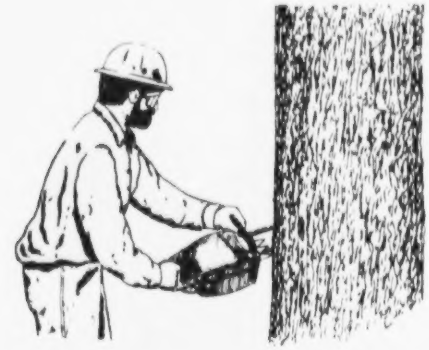
R. A small brush should be used to clean machines after operations are completed.

S. When oiling or adjusting a machine, be sure the power switch is "off."

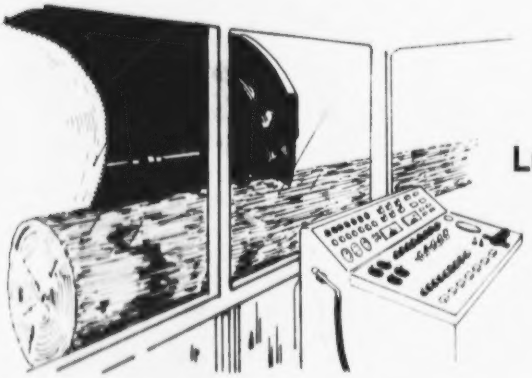
T. If an object is too heavy or awkward, get help.

U. Oily rags used to wipe down machines should be placed in a metal container.

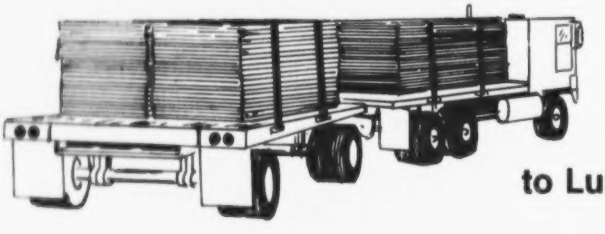
Operations in Processing Technology



Pre-Processing

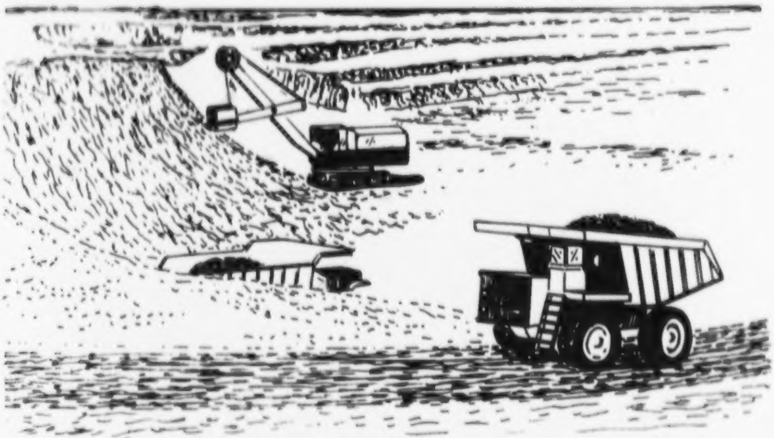

Lumber Mill

Processing

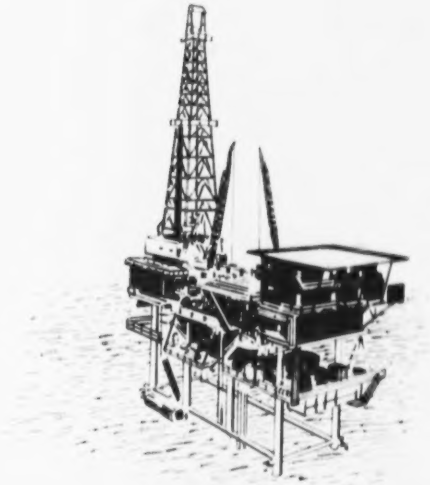

to Lumber Yard

Post-Processing

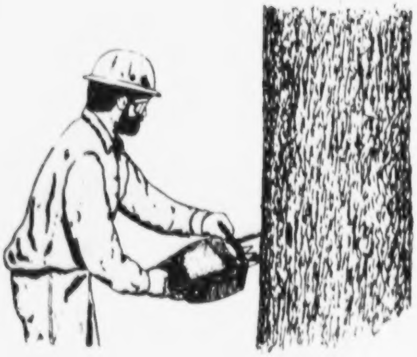
Primary Manufacturing Processes



Mining

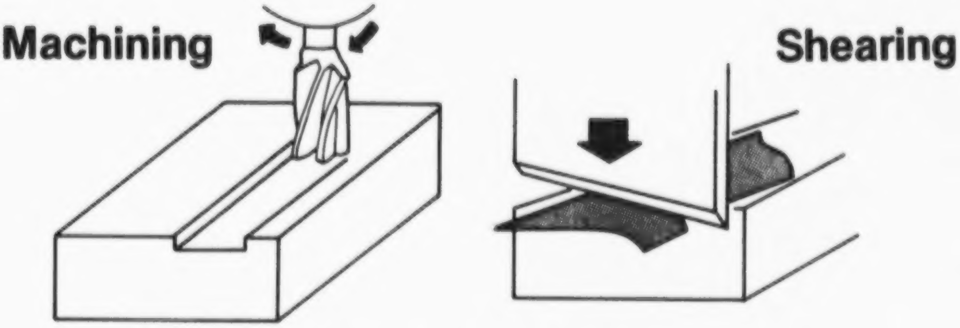


Drilling and Refining

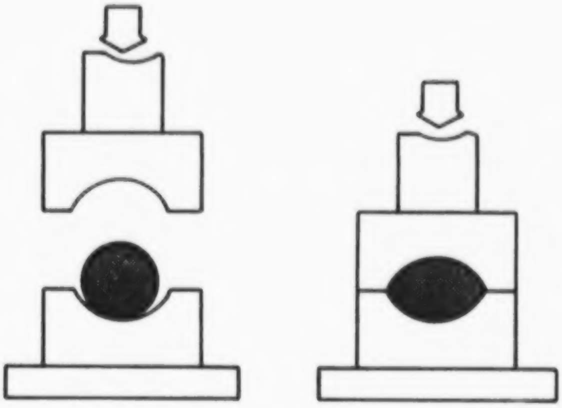


Harvesting

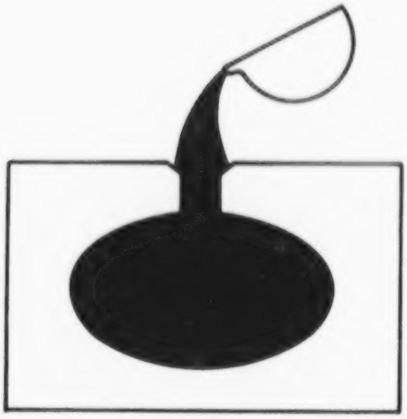
Secondary Manufacturing Processes


Machining
Shearing

Separating



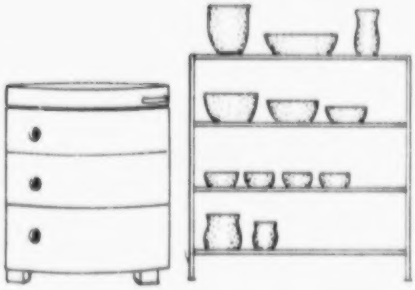
Forming



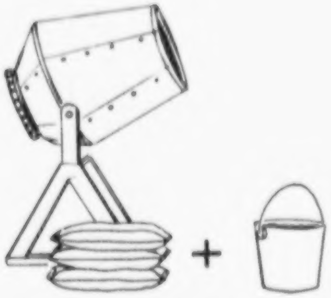
Casting

Secondary Manufacturing Processes

(Continued)

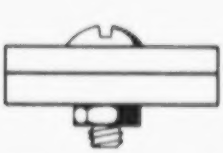


Thermal

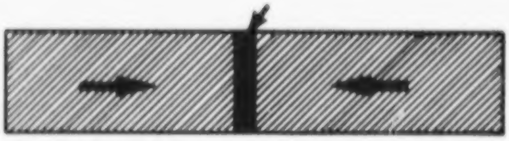


Chemical

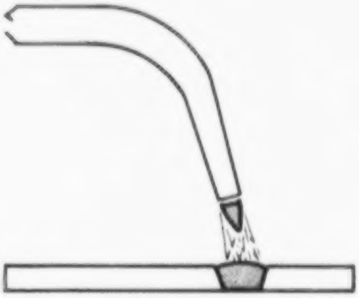
Conditioning



Mechanical Fasteners



Adhesives

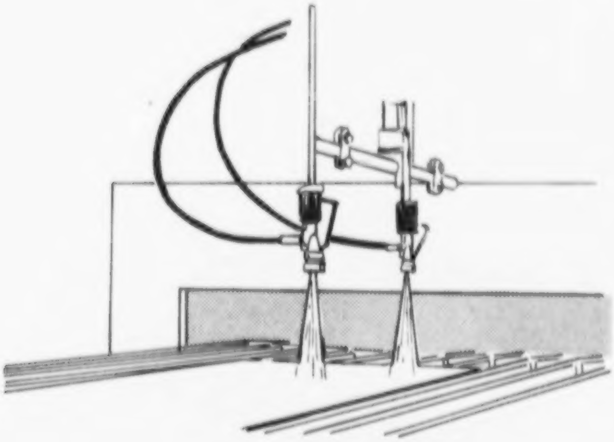


Welding

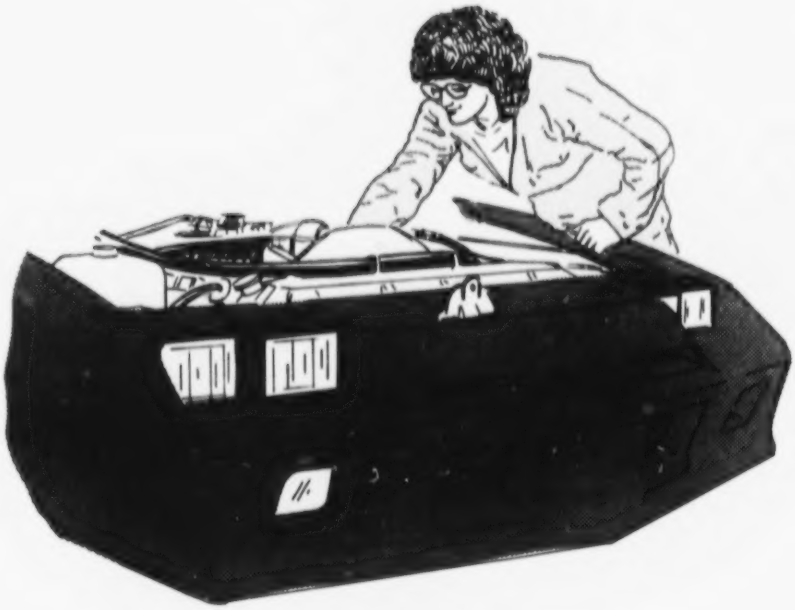
Assembling

Secondary Manufacturing Processes

(Continued)

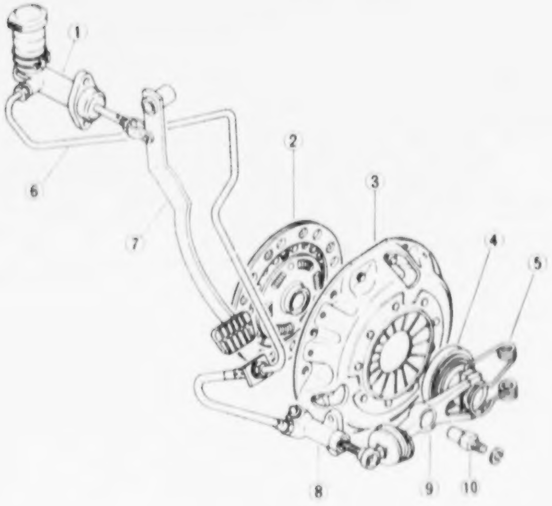


Finishing

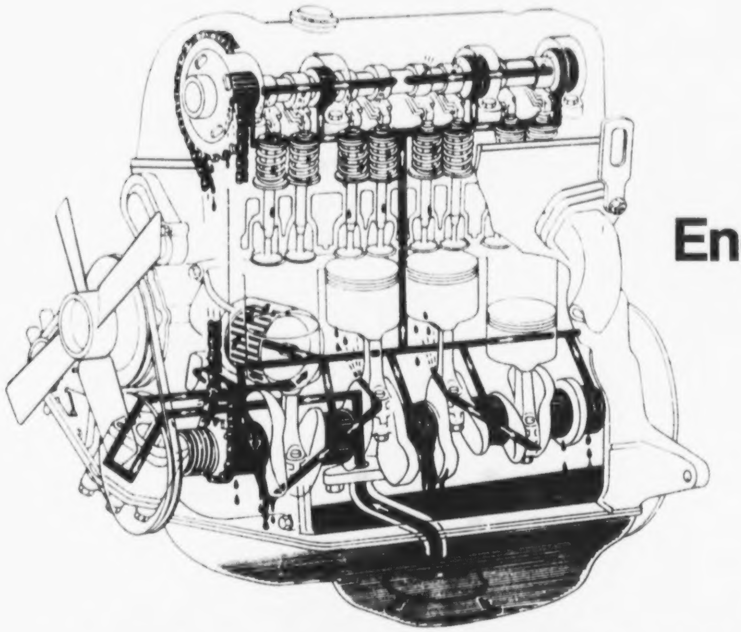


Servicing

Subassemblies



Clutch



Engine

These are only two of the many subassemblies that will be used to make the final assembly. See TM 7.

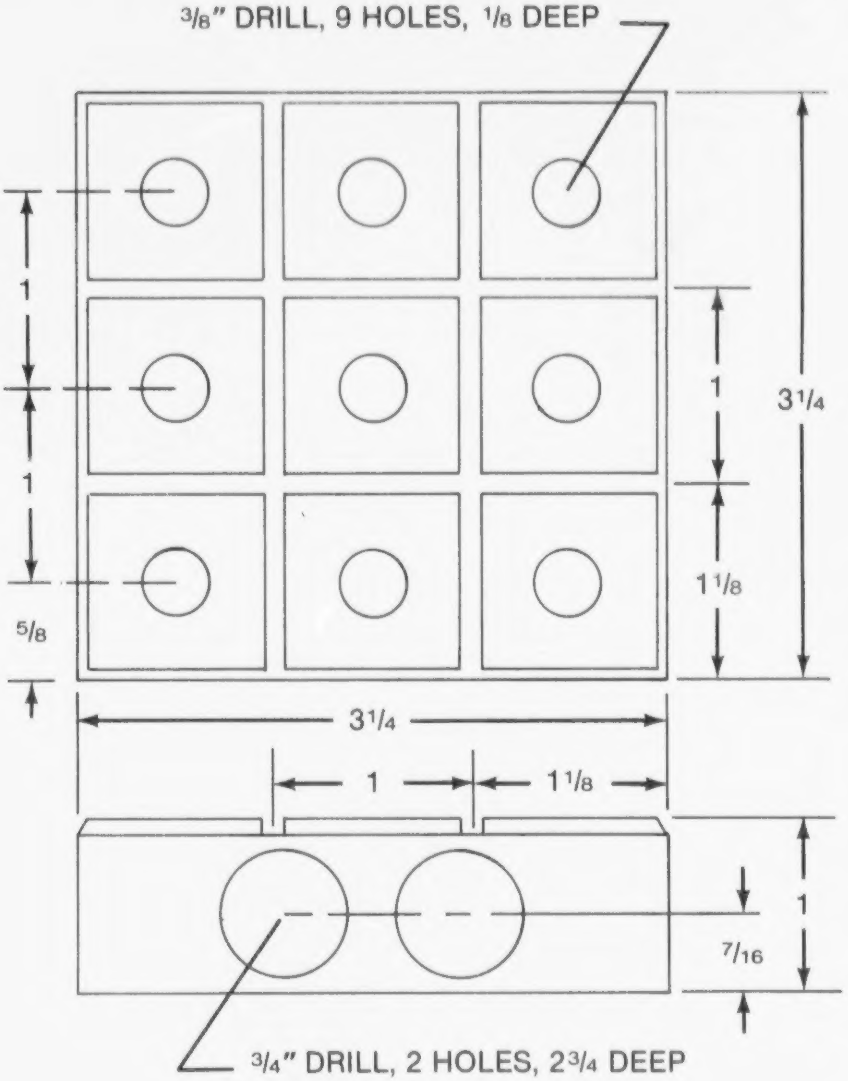
Final Assembly

Automobile

The Product Ready for the Customer.

MANUFACTURING PROCESSES
UNIT IV-D

HANDOUT #1 — TIC-TAC-TOE GAME BASIC MEASUREMENTS


3/8" DRILL, 9 HOLES, 1/8 DEEP
1
1
5/8
1
1 1/8
3 1/4
3 1/4
1
1 1/8
1
7/16
3/4" DRILL, 2 HOLES, 2 3/4 DEEP

(NOTE: All measurements are in inches.)

MANUFACTURING PROCESSES
UNIT IV-D

HANDOUT #2 — FLOW PROCESS CHART

	PRESENT		PROPOSED		DIFFERENCE	
	NO.	TIME	NO.	TIME	NO.	TIME
Operations						
Transportations						
Inspections						
Delays						
Storages						
Distance Traveled						

Job ______________________________

☐ Man Or ☐ Material __________

Chart Begins ____________________

Chart Ends ______________________

Charted By ____________ Date ______

									ANALYSIS						ACTION			
									WHY?									
DETAILS OF (PRESENT) (PROPOSED) METHOD	OPERATION	TRANSPORT	INSPECTION	DELAY	STORAGE	DISTANCE IN FEET	QUANTITY	TIME	WHAT?	WHERE?	WHEN?	WHO?	HOW?		ELIMINATE	COMBINE	CHG. SEQ.	SIMPLIFY
	○	⇨	□	D	▽													
	○	⇨	□	D	▽													
	○	⇨	□	D	▽													
	○	⇨	□	D	▽													
	○	⇨	□	D	▽													
	○	⇨	□	D	▽													
	○	⇨	□	D	▽													
	○	⇨	□	D	▽													
	○	⇨	□	D	▽													
	○	⇨	□	D	▽													
	○	⇨	□	D	▽													
	○	⇨	□	D	▽													
	○	⇨	□	D	▽													
	○	⇨	□	D	▽													
	○	⇨	□	D	▽													

MANUFACTURING PROCESSES
UNIT IV-D

ASSIGNMENT SHEET #1 — IDENTIFY TOOLS AND MACHINES IN YOUR LABORATORY THAT ARE USED FOR SEPARATING

NAME ______________________________ SCORE ____________

Directions: Write the names of those tools and machines in your laboratory that are used for separating.

TOOLS	MACHINES
1. ____________________	1. ____________________
2. ____________________	2. ____________________
3. ____________________	3. ____________________
4. ____________________	4. ____________________
5. ____________________	5. ____________________
6. ____________________	6. ____________________
7. ____________________	7. ____________________
8. ____________________	8. ____________________
9. ____________________	9. ____________________
10. ____________________	10. ____________________
11. ____________________	11. ____________________
12. ____________________	12. ____________________

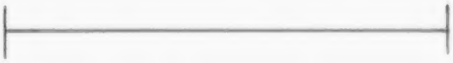
MANUFACTURING PROCESSES
UNIT IV-D

ASSIGNMENT SHEET #2 — MEASURE DISTANCES USING BOTH ENGLISH AND METRIC SCALES

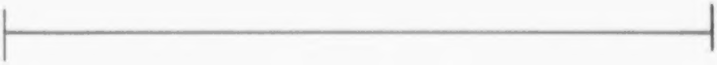
NAME ______________________________ SCORE __________

Directions: Measure the following lines to the nearest 1/16" and millimeter. Record your answers in the space provided.

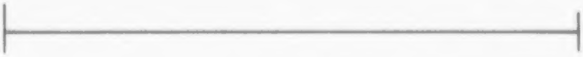
1. ______ Inches
______ Millimeters



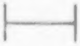
2. ______ Inches
______ Millimeters



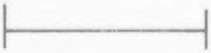
3. ______ Inches
______ Millimeters



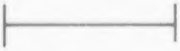
4. ______ Inches
______ Millimeters



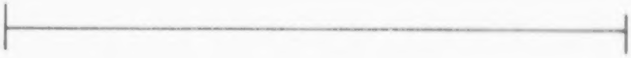
5. ______ Inches
______ Millimeters



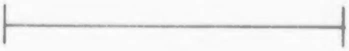
6. ______ Inches
______ Millimeters



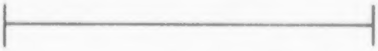
7. ______ Inches
______ Millimeters



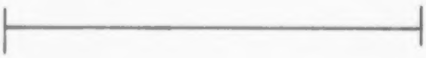
8. ______ Inches
______ Millimeters



9. ______ Inches
______ Millimeters



10. ______ Inches
______ Millimeters



MANUFACTURING PROCESSES
UNIT IV-D

ASSIGNMENT SHEET #3 — IDENTIFY THE SUBASSEMBLIES THAT MAKE UP A SMALL HAND OR POWER TOOL

NAME ______________________________ SCORE ____________

Directions: Disassemble a small out-of-service hand or power tool (provided by your instructor) and list the names or descriptions of the various subassemblies. Once this is complete, reassemble the tool and return to your instructor.

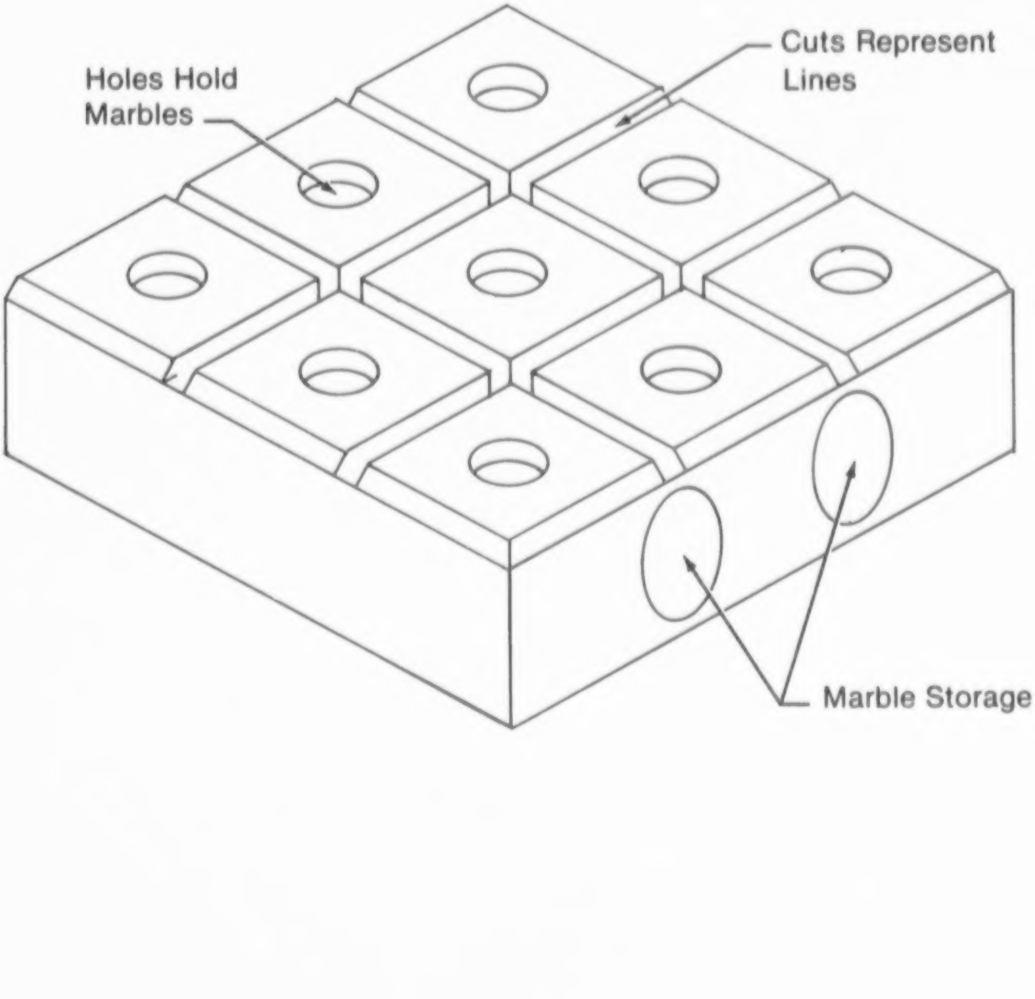
1. ____
2. ____
3. ____
4. ____
5. ____
6. ____
7. ____
8. ____
9. ____
10. ____
11. ____
12. ____

MANUFACTURING PROCESSES
UNIT IV-D

ASSIGNMENT SHEET #4 — MODIFY A BASIC DESIGN FOR MASS PRODUCTION

NAME ______________________________ SCORE ____________

A Tic-Tac-Toe game will be manufactured by your class as part of an industrial simulation activity. The major component of this game is pictured below. Marbles (two different colors) are used to represent X's and O's. These marbles can be stored in the large holes in the side.


Holes Hold Marbles
Cuts Represent Lines
Marble Storage

ASSIGNMENT SHEET #4

Specific conditions:

1. The object will be manufactured from a solid piece of fir, spruce, or pine.
2. All operations will be designed so they may be easily repeated.

Problem:

Design a system that will block the marble storage holes while the game is not in use. The solution should be submitted on a clean sheet of 8½" × 11" paper. Criteria for grading:

1.	Sketches and descriptions are neat.	30%
2.	Workability of the solution.	30%
3.	Ease with which the solution can be implemented.	30%
4.	Creativity	10%

MANUFACTURING PROCESSES
UNIT IV-D

JOB SHEET #1 — OPERATE THE SCROLL SAW TO MAKE CURVED CUTS

A. Tools and materials

1. Scroll saw
2. Lumber stock (shelving pine (1" × 12")
3. Safety glasses or goggles
4. Compass
5. Pencil

B. Scroll saw safety rules

1. Wear proper clothing while operating this machine.
2. Wear face shield, safety glasses, or goggles.
3. Cut only stock with a flat surface on bottom.
4. Make adjustments only when machine is at a dead stop.
5. Install saw blades to cut on the downstroke.
6. Tighten blade securely in lower vise, then in upper vise. Check blade for correct tension.
7. Make sure the saw blade is the proper size for the job.
8. Adjust hold-down so it will be as close as possible to the work.
9. Turn machine by hand to make sure all parts are clear.
10. Make sure that no one but you is inside the operator's zone.
11. Select correct machine speed.
12. Lower the hold-down foot to press lightly on the surface of the wood.
13. Turn on power after permission is given.
14. Hold material firmly.

JOB SHEET #1

15. Feed the material into the machine at a moderate rate of speed.

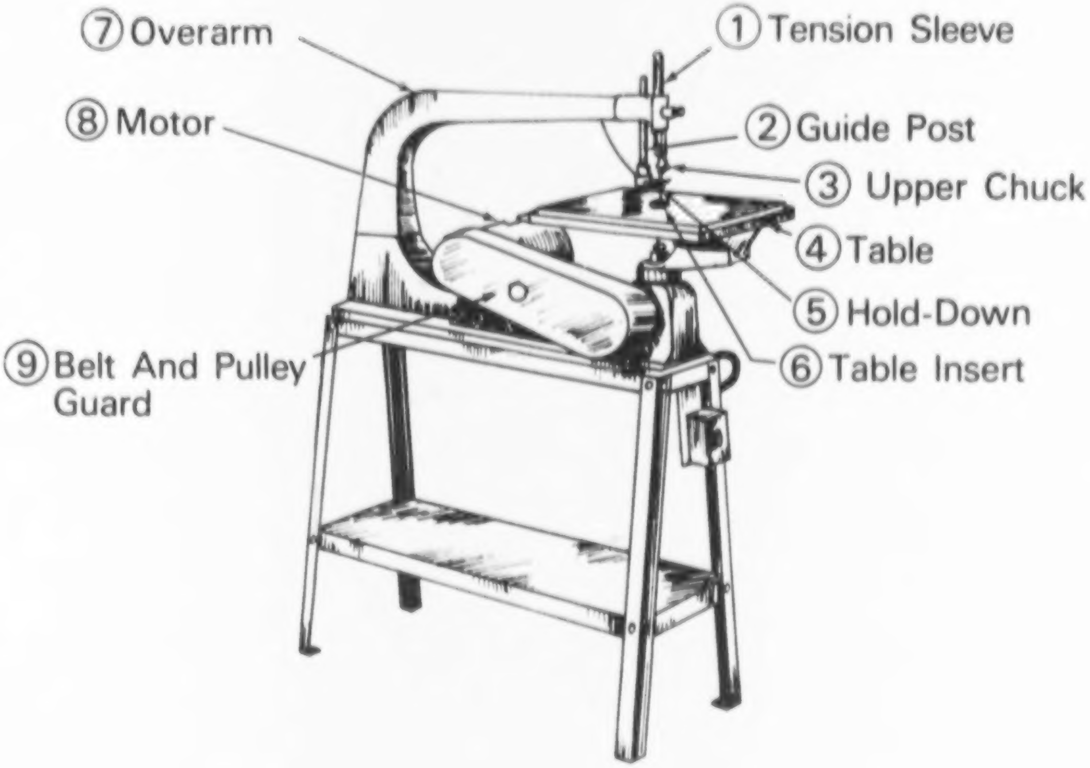
16. Keep fingers away from saw and hands out of the path of saw.

17. Report mechanical defects or a broken blade to the instructor.

18. Turn off power after using scroll saw and stand by until the machine has stopped.

19. Clear away scraps of wood on the table only after saw stops running.

C. Scroll saw parts

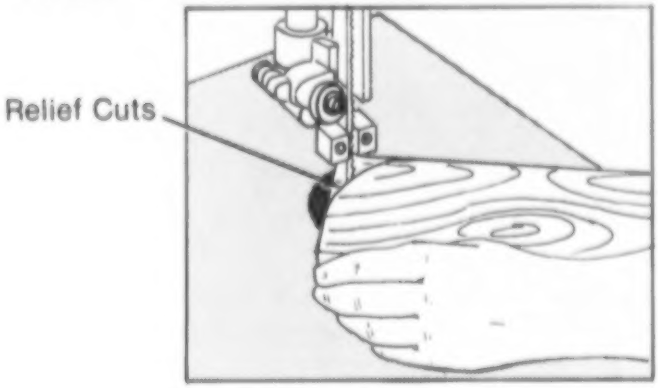

⑦ Overarm
① Tension Sleeve
⑧ Motor
② Guide Post
③ Upper Chuck
④ Table
⑤ Hold-Down
⑨ Belt And Pulley Guard
⑥ Table Insert

JOB SHEET #1

D. Procedure

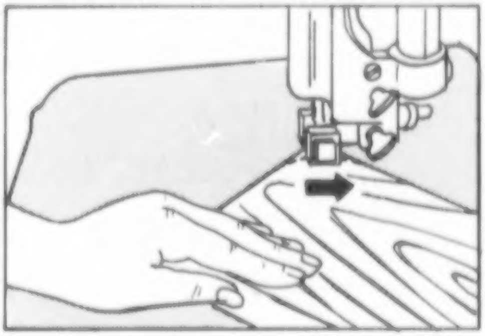
1. Obtain permission from your instructor to use the scroll saw.
2. Put on safety glasses or goggles.
3. Mark stock using a compass and pencil with a 4" circle. (Minimize waste)
4. Adjust hold-down so it is as close as possible to the work.
5. Check condition of blade to make sure it is sharp and square with table.
6. Turn on machine. Make sure that it is running at full speed before you begin to cut.
7. Make relief cuts through the waste stock to the curved line. (Figure 1)

FIGURE 1



8. Make final cut gradually, but firmly on the waste side of the line. (Figure 2)

FIGURE 2



9. Turn off machine.
10. Clean area and return tools and materials to correct areas.

MANUFACTURING PROCESSES
UNIT IV-D

JOB SHEET #2 — OPERATE THE DRILL PRESS TO CUT HOLES IN ACRYLIC STOCK

A. Tools and materials

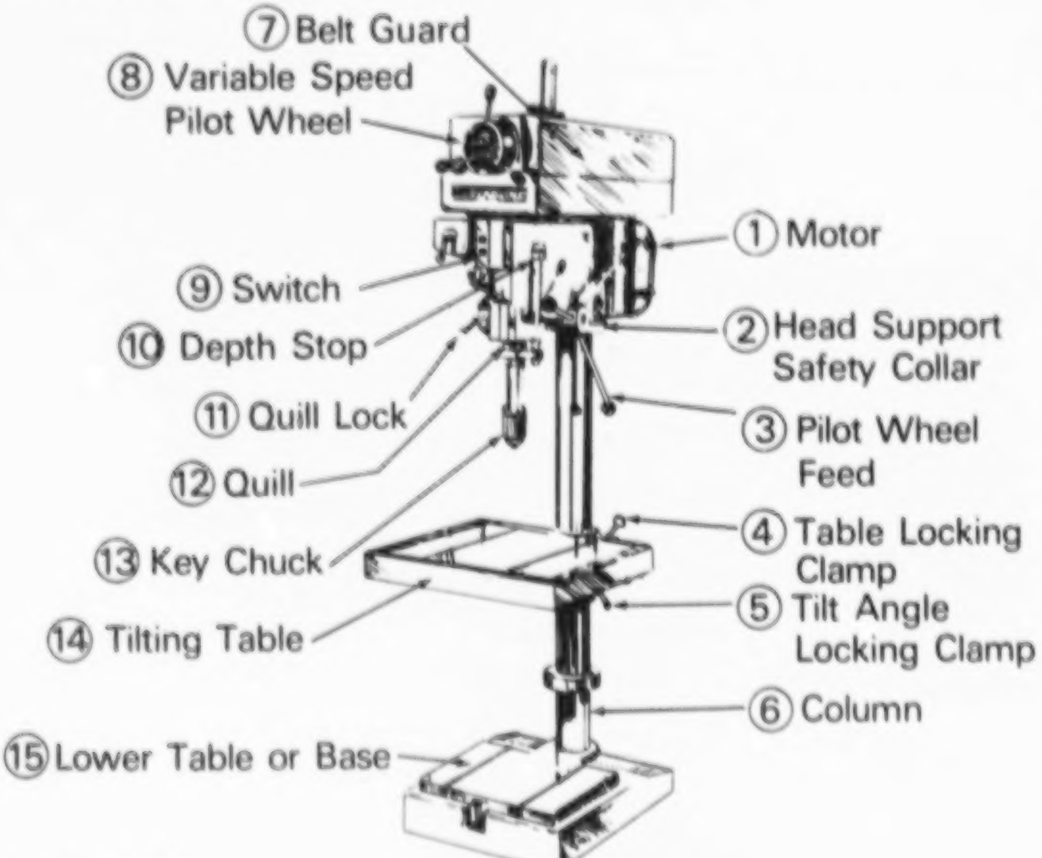
1. Drill press
2. Parallel bar clamp or C clamp
3. 1/8" twist drill for plastics
4. 1 - 2" × 4" piece of 1/2" acrylic (Plexiglas) stock
5. Center punch
6. Pencil
7. Scale or ruler
8. Straight edge
9. Safety glasses or goggles
10. Hammer

B. Drill press safety rules

1. Wear proper clothing. Remove jewelry and confine loose clothing and long hair.
2. Make sure all guards are in place and are operating properly.
3. Always use proper eye protection.
4. Hold material securely with vise or clamps.
5. Be sure key is removed from chuck.
6. Select a properly sharpened bit. For metal, center punch where hole is to be drilled.
7. Turn off power if the drill is caught in the work piece.
8. Adjust table or depth stop to avoid drilling into the table.
9. Select the correct speed. Normally use a slower speed for metal than for wood. The larger the bit, the slower the speed.
10. Store chuck key in a holder after use. Do not allow it to hang on the drill press.

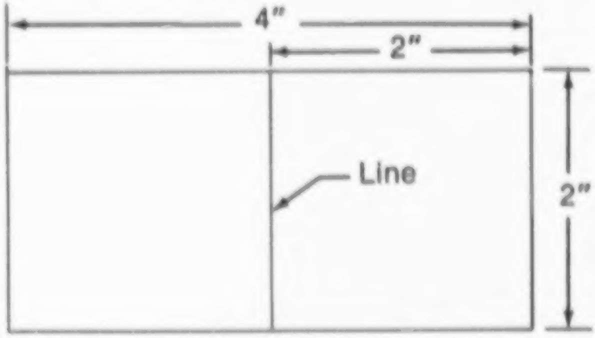
JOB SHEET #2

C. Drill press parts


⑦ Belt Guard
⑧ Variable Speed Pilot Wheel
① Motor
⑨ Switch
② Head Support Safety Collar
⑩ Depth Stop
⑪ Quill Lock
③ Pilot Wheel Feed
⑫ Quill
④ Table Locking Clamp
⑬ Key Chuck
⑤ Tilt Angle Locking Clamp
⑭ Tilting Table
⑥ Column
⑮ Lower Table or Base

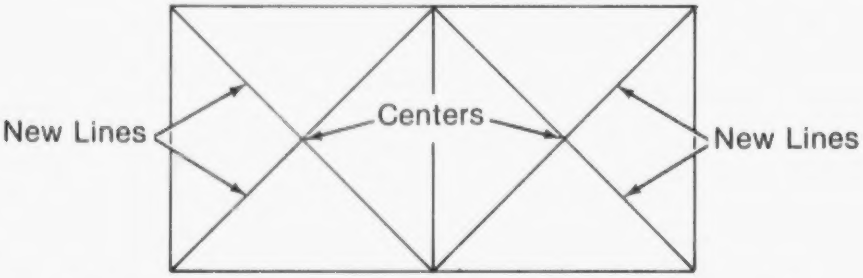
D. Procedure

1. Put on safety glasses or goggles.
2. Obtain acrylic stock from instructor. Paper coating should still be on the stock.
3. Layout the following line on the stock.

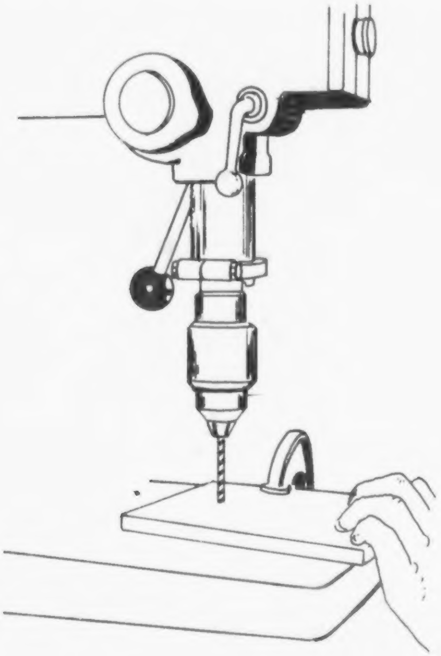


JOB SHEET #2

4. Once you have located the center line which forms a square on each side of the line, locate the center of each square as follows:



5. Use a center punch and hammer to lightly dent the two centers.
6. Set up the drill press so the 1/8" twist drill barely enters a piece of flat stock that is lying on the tilting table. (Drill must be perpendicular with the table.)
7. Place marked and punched stock on the table (on top of wood stock).



8. Center one punched hole beneath twist drill.
9. Drill hole through stock.
10. Repeat steps 8 and 9 for second hole.
11. Clean area and properly store tools and materials.

MANUFACTURING PROCESSES
UNIT IV-D

JOB SHEET #1 PRACTICAL TEST — OPERATE THE SCROLL SAW TO MAKE CURVED CUTS

STUDENT'S NAME ______________________________ DATE ____________

EVALUATOR'S NAME ____________________________ ATTEMPT NO. ______

Instructions: When you are ready to perform this task, ask you instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:		YES	NO
1.	Checked out proper tools and materials.	______	______
2.	Put on safety glasses.	______	______
3.	Marked stock using compass (4" circle).	______	______
4.	Set hold-down.	______	______
5.	Checked condition of blade.	______	______
6.	Turned on machine.	______	______
7.	Made relief cuts.	______	______
8.	Made final cut.	______	______
9.	Turn off machine.	______	______
10.	Cleaned area.	______	______
11.	Properly stored tools.	______	______
12.	Practiced safety rules throughout procedure.	______	______
13.	Provided satisfactory responses to questions asked.	______	______

EVALUATOR'S COMMENTS: ____

____

PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
	4	3	2	1
Cut is smooth				
	4	3	2	1
Circle is 4" in diameter				
	4	3	2	1
Stock is not damaged				
	4	3	2	1

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled — Can perform job with no additional training.
3 — Moderately skilled — Has performed job during training program; limited additional training may be required.
2 — Limited skill — Has performed job during training program; additional training is required to develop skill.
1 — Unskilled — Is familar with process, but is unable to perform job.

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

MANUFACTURING PROCESSES
UNIT IV-D

JOB SHEET #2 PRACTICAL TEST — OPERATE A DRILL PRESS TO CUT HOLES IN ACRYLIC STOCK

STUDENT'S NAME ______________________________ DATE ____________

EVALUATOR'S NAME ______________________________ ATTEMPT NO. ______

Instructions: When you are ready to perform this task, ask you instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:	YES	NO
1. Checked out proper tools and materials.	______	______
2. Put on safety glasses.	______	______
3. Measured and marked stock for drilling.	______	______
4. Drilled holes (2).	______	______
5. Cleaned area.	______	______
6. Properly stored tools. ·	______	______
7. Practiced safety rules throughout procedure.	______	______
8. Provided satisfactory responses to questions asked.	______	______

EVALUATOR'S COMMENTS: ____

____

PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:				
	4	3	2	1
Hole is vertical				
	4	3	2	1
Hold is smooth and free of burrs				
	4	3	2	1
Hole is round and not elongated				
	4	3	2	1
Stock is not damaged				
	4	3	2	1

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled — Can perform job with no additional training.
3 — Moderately skilled — Has performed job during training program; limited additional training may be required.
2 — Limited skill — Has performed job during training program; additional training is required to develop skill.
1 — Unskilled — Is familar with process, but is unable to perform job.

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

MANUFACTURING PROCESSES
UNIT IV-D

NAME ______________________________ SCORE ______________________

TEST

1. Classify each operation in the following list as either "pre" (pre-processing), "post" (post-processing), and/or "pro" (processing).

______a. Transporting

______b. Distributing

______c. Reducing in size

______d. Conditioning

______e. Drilling

______f. Extracting

______g. Forming and combining

2. Distinguish between primary and secondary manufacturing processes by placing a "P" next to primary or an "S" next to the secondary manufacturing processes.

______a. Conditioning by heat treatment

______b. Cutting trees down

______c. Refining petroleum

______d. Assembling a radio

______e. Mining metal ores

______f. Slaughtering animals

______g. Painting a container

______h. Sawing a board

______i. Casting a part

______j. Drilling holes in a part

TEST

3. Distinguish between the major types of separating processes by placing an "X" next to the description of **machining.**

______a. Changing size and shape by removing excess materials by chips

______b. Using opposing edges to fracture the excess material away

4. Select from the following list the correct elements of the forming process by placing an "X" in the appropriate blanks.

______a. Molds and casts

______b. Dies and rolls

______c. Correct temperature of material

______d. Hammers, presses, or rollers

______e. Drills, routers, or saws

5. Arrange in order the following steps of the casting process by placing the correct sequence numbers (1-5) in the appropriate blanks.

______a. Material is allowed or forced to harden.

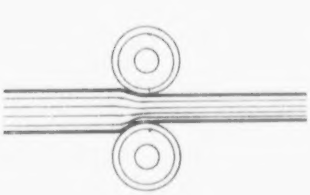
______b. Material is poured or forced under pressure into the mold.

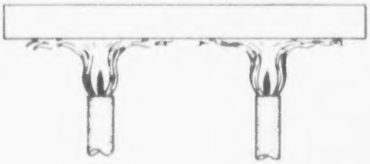
______c. A mold of the proper shape is produced.

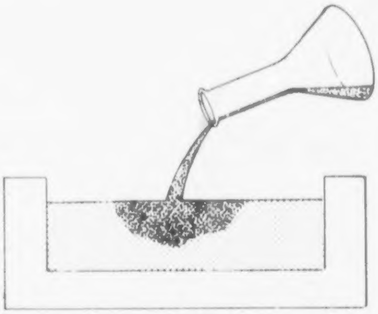
______d. The material is prepared for casting (liquid state).

______e. The finished item is removed from the mold.

6. Distinguish between the types of conditioning processes by placing the correct names next to the following illustrations: Thermal, chemical, mechanical







a. ______________________ b. ______________________ c. ______________________

TEST

7. Complete the following statements concerning assembly processes by circling the correct words.

   a. Any product made up of (**one, more than one**) part is called an assembly.

   b. A (**primary assembly, subassembly**) is an assembly that will be combined with other assemblies to make a product.

   c. A final assembly is a finished product that goes to the (**design and testing department, customers**).

   d. Assembly operations include mechanical fasteners, welding, and (**adhesives, clamping**).

8. Distinguish between the major finishing operations by placing the following letters next to the correct descriptions:

   - CL — Cleaning
   - T — Treating
   - CO — Coating (or plating)

   ______a. Includes all those processes by which a protective or decorative material is added to the surface.

   ______b. Using brushes or chemicals to remove deposits of grease, dust, rust, or other impurities on the surface of the product.

   ______c. Includes a number of finishing operations whose purpose is to prepare the surface for a coating process.

9. Complete the following statements concerning the major types of maintenance by filling in the blanks with the correct words: Preventive, minor, major.

   a. ____________ maintenance — All the somewhat expected replacement/repair operations which are fairly easy to do and can be done rather quickly.

   b. ____________ maintenance — Extensive replacement or repair; includes such operations as complete overhaul or complete reconditioning.

   c. ____________ maintenance — Planned lubrication, adjustment, cleaning, and tuning operations so more serious unexpected problems can be avoided.

10. Select the following true statements concerning general safety rules by placing an "X" next to the true statements.

   ______a. Always wear proper eye protection devices.

   ______b. Make all adjustments on machines after turning on the power.

   ______c. Start feeding the work into the machine as soon as you turn on the power.

   ______d. Inform the instructor immediately of any improperly-working machine.

   ______e. Hands should be kept a minimum distance of 4" from the cutting tool.

TEST

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

11. Identify tools and machines in your laboratory that are used for separating. (Assignment Sheet #1).

12. Measure distances using both English and metric scales. (Assignment Sheet #2)

13. Identify the subassemblies that make up a small hand or power tool. (Assignment Sheet #3)

14. Modify a basic design for mass production. (Assignment Sheet #4)

15. Demonstrate the ability to:

    a. Operate the scroll saw to make curved cuts. (Job Sheet #1)

    b. Operate the drill press to cut holes in acrylic stock. (Job Sheet #2)

MANUFACTURING PROCESSES
UNIT IV-D

ANSWERS TO TEST

1. a. Pre or post
   b. Post
   c. Pro
   d. Pro
   e. Pre
   f. Pre
   g. Pro

2. a. S
   b. P
   c. P
   d. S
   e. P
   f. P
   g. S
   h. S
   i. S
   j. S

3. a

4. b, c, d

5. a. 4
   b. 3
   c. 1
   d. 2
   e. 5

6. a. Mechanical
   b. Thermal
   c. Chemical

7. a. More than one
   b. Subassembly
   c. Customers
   d. Adhesives

8. a. CO
   b. CL
   c. T

9. a. Minor
   b. Major
   c. Preventive

10. a, d, e

11.-14. Evaluated to the satisfaction of the instructor

15. Performance skills evaluated to the satisfaction of the instructor

MANUFACTURING PROCESS PLANNING
UNIT V-D

UNIT OBJECTIVE

After completion of this unit, the student should be able to distinguish between the major areas of a manufacturing industry. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to process planning with the correct definitions.
2. Match major areas within a manufacturing organization with their descriptions.
3. Distinguish between the basic functions of the financial affairs and accounting division of a business.
4. State the purpose of a budget used by management in a manufacturing organization.
5. Complete statements that describe the types of budgets and estimates that are used within manufacturing organizations.
6. Distinguish between the major areas of the industrial relations area of a company.
7. Complete statements concerning the responsibilities of the research and development area of an organization.
8. Complete statements describing the production activities that occur within a company.
9. List the four major steps that occur during the production phase of a manufacturing operation.

OBJECTIVE SHEET

10. Match the functions of marketing with the correct descriptions.

11. Develop a guide for evaluating production worker performance. (Assignment Sheet #1)

12. Describe worker performance during a mass production activity. (Assignment Sheet #2)

MANUFACTURING PROCESS PLANNING
UNIT V-D

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Show and discuss examples of simple flow charts which will help in the planning of manufacturing operations. They should include the major activities between securing stock to distributing the product. Show the prototype that you made.
2. Have the class management team prepare a plan that provides a list of objectives to be accomplished during each day of production. Help this team prepare a detailed flow chart.
3. Conduct the production activity and have periodic five to ten minute evaluations to facilitate smooth operations. Have the class make adjustments when necessary.
4. Conduct an overall evaluation of the production activity which should result in a list of processes that went well and processes that could be improved upon.
5. Discuss the evaluation forms that were developed (Assignment Sheet #1) by the students and identify one that will be used by the supervisors to evaluate their subordinates. Discuss what makes a good employee and a good boss. What happens when the boss's and the employee's expectations are not met?
6. Role play a management-labor negotiation.
7. Discuss the importance of a "good attitude" by all concerned.
8. Consider evaluations in determining the students' grades.
9. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Give test.

SUGGESTED ACTIVITIES

I. Evaluate test.

J. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. *Industrial Education: Materials & Processes*, C.B.I.E. Project. Topeka: Kansas State Department of Education, 1972.

B. *Manufacturing*. Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc., 1977.

C. *Secondary Exploration of Technology*. Topeka: Kansas State College of Pittsburg, The State Department of Education, 1974.

D. Wright, R. Thomas and Richard M. Henak. *Exploring Production*. South Holland, IL: Goodheart-Willcox Co., 1985.

SUGGESTED SUPPLEMENTAL RESOURCES

Films

A. *Automation — What Is It?* (13 min.)
National Association of Manufacturers
277 Park Avenue
New York, NY 10017

B. *Fundamentals of Quality Control* (16 min.)
Maynard Research Council, Inc.
718 Wallace Avenue
Pittsburgh, PA 15221

C. *Industrial Research — Key to Jobs and Progress* (13 min.)
National Association of Manufacturers
2 East 48th Street
New York, NY 10017

D. *Quality Control* (10 min.)
University of Illinois
Visual Aids Service
Champaign, IL 61822

E. *Quality in Quantity* (13 min.)
National Association of Manufacturers
277 Park Avenue
New York, NY 10017

MANUFACTURING PROCESS PLANNING
UNIT V-D

INFORMATION SHEET

I. **Terms and definitions**

A. Fixed costs — Costs that are unlikely to change such as rent and utilities

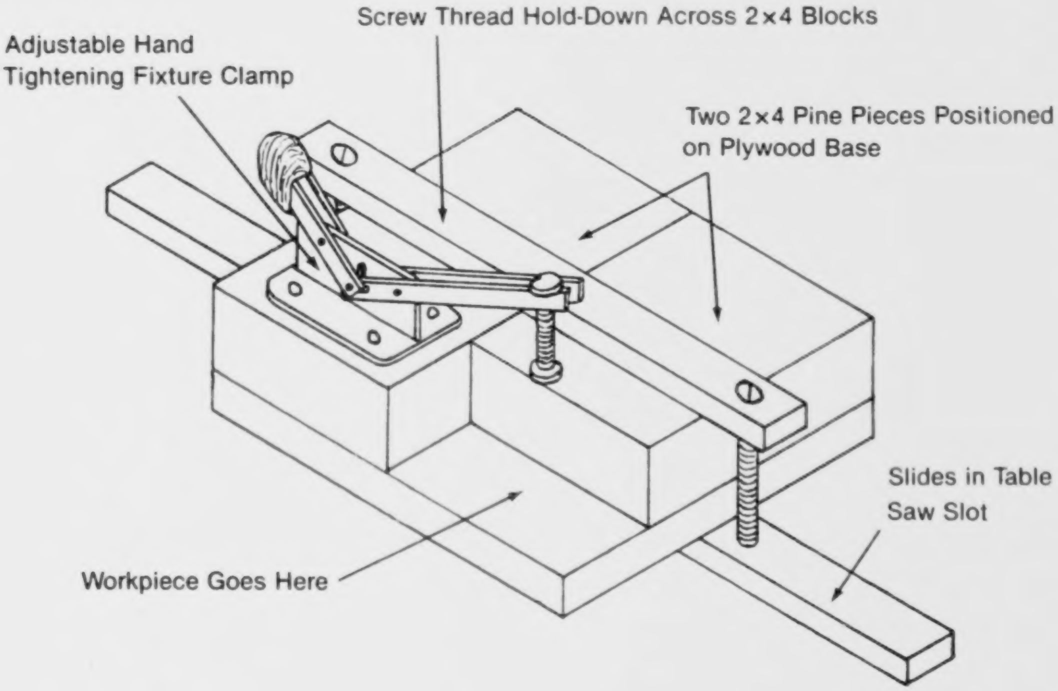
B. Flow chart — Diagram that indicates the order of operations as materials move through a series of processes to become a finished product (Handouts #1-#2)

C. Gauges — Devices used for measuring and for checking the accuracy of parts

D. Interchangeability of parts — Parts produced in quantity, any one of which will fit the assembly for which it is to be a component

E. Jigs and fixtures — Devices used to maintain the correct position between the workpiece and the tool during machining or assembly

FIGURE 1 — Table saw fixture


Screw Thread Hold-Down Across 2×4 Blocks
Adjustable Hand Tightening Fixture Clamp
Two 2×4 Pine Pieces Positioned on Plywood Base
Slides in Table Saw Slot
Workpiece Goes Here

INFORMATION SHEET

F. Overhead — Expenses such as rent, insurance, and utilities that are not chargeable to a particular part of the work or product

G. Variable costs — Costs that are dependent on external conditions such as labor and materials

II. **Areas within a manufacturing organization** (Transparency 1)

A. Finance and accounting — Provides and controls money

B. Industrial relations — Provides personnel to meet the needs of the process

C. Research and development — Develops and prepares the product to be produced

D. Production — Manufactures the product

E. Marketing — Sells and distributes the product

III. **Functions of the financial affairs and accounting division (Transparency 2)**

A. Finance — Obtaining sufficient operating funds and investing surplus funds

B. Control — Maintaining records and preparing financial reports

C. Purchasing — Buying the quantity and quality of materials, services, and equipment needed

(NOTE: The number of people required to carry on these functions depends upon the size of the company. A small firm may employ one or two people to manage the area; larger firms with greater cash flows employ many people in financial affairs and accounting.)

IV. **Purpose of a budget used by management in a manufacturing organization —** To provide a way of estimating expenses so that an adequate amount of money can be available and to control costs.

(NOTE: Money is needed for a variety of purposes such as equipment, salaries, taxes, building, product development, operating licenses, materials, legal fees, and advertising.)

V. **Types of budgets and estimates used within manufacturing organizations**

(NOTE: Depending upon the size and purpose of the company, several different budgets may be prepared.)

A. Sales estimate

1. Is developed from the sales forecast
2. Projects income from data provided by market research or from previous years

INFORMATION SHEET

B. Production expense budget (Figure 2)

1. Estimates and attempts to define all expenses resulting from production. The volume of production is based upon the sales forecast prepared earlier.

2. Four major areas are considered in this budget.

    a. Materials cost

    b. Tooling and equipment cost

    c. Labor cost

    d. Production overhead cost (utilities, maintenance, facility rental, and support personnel wages)

FIGURE 2

Manufacturing Technology
Hang-a-Cup Company
Lincoln High School
1987

PRODUCTION EXPENSE BUDGET

Direct Costs	
Materials	$64.70
Labor	No Charge
Total	$64.70
Indirect Costs	
Machines	No Charge
Work spoilage	$3.99
Advertising	No Charge
Total	$60.71
Cost of Production	$60.71
Unit Cost	$3.70

C. General expense budget — Projects expense of maintaining a company office (management salaries, office personnel salaries, office supplies, etc.) and operating and marketing program

D. Financial budget — Summarizes projected income and expenses for a specific time period

E. Master budget

1. Used by the top level management to develop an overall financial picture of the company

2. Includes a summary of the other budgets, as well as a sales forecast and profit and loss projection. From this information the company executives make decisions affecting the operation of the company.

INFORMATION SHEET

VI. **Major areas of the industrial relations area of a company** (Transparency 3)

(NOTE: The number of people required to carry on the function of these areas depends upon the size of the company, type of enterprise being carried on, and the products being sold.)

A. Personnel relations

1. Develops the labor force of human resources needed by the enterprise

2. Provides for hiring and firing people, as well as for employment training, safety seminars, employee services, etc.

B. Labor relations

1. Attempts to promote and maintain positive relations and attitudes between the company and the workers

2. If the relationship between the company and the workers breaks down, collective bargaining and grievance procedures may be used.

C. Public relations

1. Is responsible for maintaining and improving the company's image in the eyes of the public

2. Promotes public acceptance of company products, procedures, and policies

VII. **Responsibilities of the research and development area of an organization** (Transparency 4)

A. Research

1. Conducted for the purpose of discovering new knowledge

2. Process is done in a controlled, organized, and systematic matter. As a result of research, knowledge and information about materials, processes, and scientific principles is increased.

B. Development

1. Involves finding applications for the knowledge that research has uncovered.

2. Looks for economical applications of the results of the research products and processes used within the company.

INFORMATION SHEET

3. A subdivision of development is product development in which creations and testing of product designs is carried on.

   (NOTE: The success of most companies is directly related to one or both of the efforts of this area. All possible design ideas for a product are reviewed and evaluated. Then the designs that seem to have the greatest potential are developed.)

VIII. **Production activities**

A. Production takes the product design generated by research and development and through the coordination of several types of sources, manufactures the product. This coordination requires a certain amount of planning before the resources can be put into motion.

B. Production may also be described as the act or process of creating or adding value to materials.

(NOTE: For example, we could buy sheet metal, hinges, handles, and locks for a certain price to produce tool boxes. The materials can not be used as tool boxes until we perform certain operations. As tool boxes, the materials serve a useful function, or have utility. We have added both functional value and dollar value to the materials as a result of the production process.)

IX. **Steps in production** (Transparency 5)

A. Production planning and control — Scheduling for labor, materials, and machines

B. Manufacturing and plant engineering — Plant layout, tooling, jigs and fixtures, templates, layout handling, time study, and method study

C. Manufacturing — Producing parts, subassemblies, and final assemblies

D. Quality control — Ensuring that the product meets standards

X. **Functions of marketing** (Transparency 6)

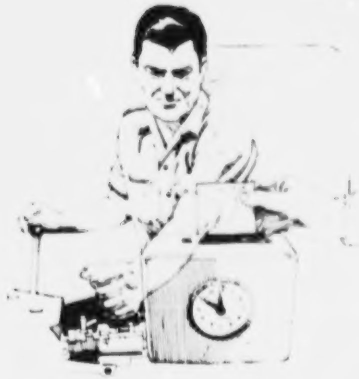
A. Market research — Gathers, analyzes, and interprets facts and opinions concerning the marketing of products.

B. Advertising — Communicates information about company products with the public to encourage sales.

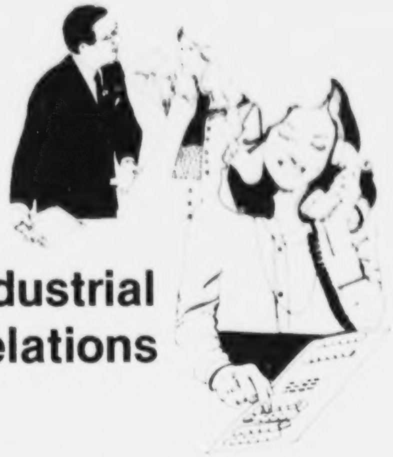
C. Sales — Provides an organized method for selling the company's products.

D. Distribution — Moves the product from the manufacturing organization to the consumer.

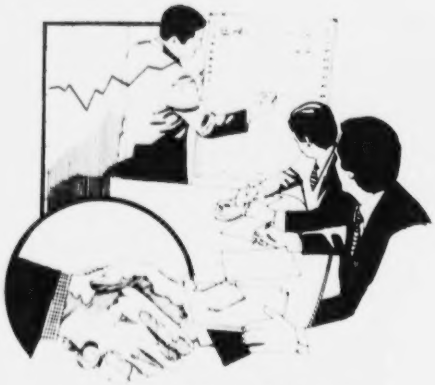
Areas Within a Manufacturing Organization



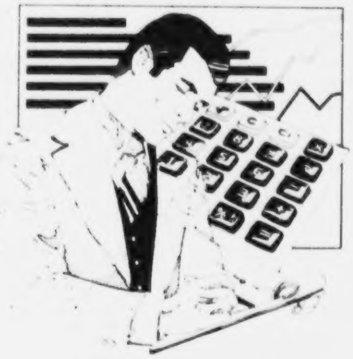
Production



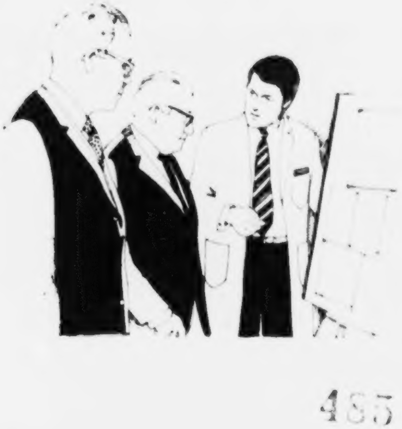
Industrial Relations



Marketing



Finance



Research and Development

ETE-193-D

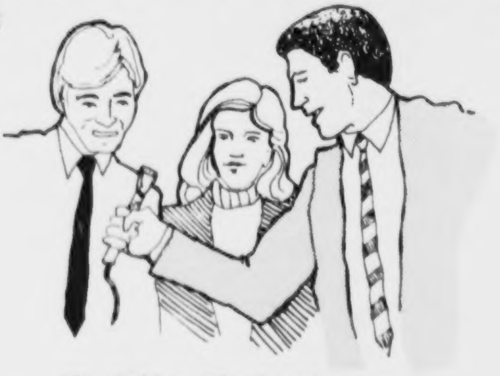
Financial Affairs & Accounting

Planning, Directing, and Measuring the Results of the Company's Operations

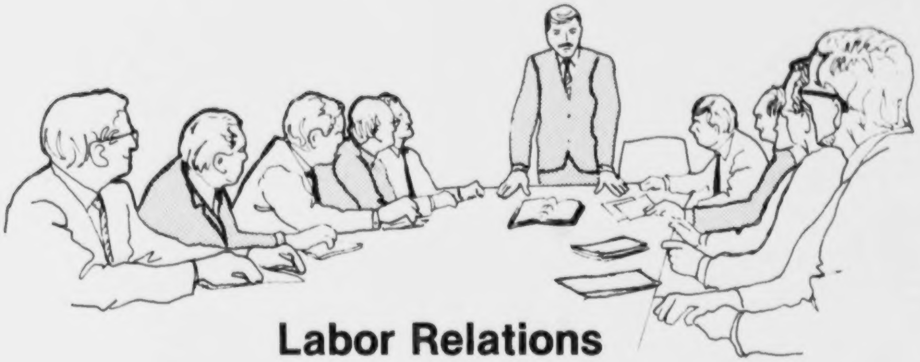
TM 2

Industrial Relations

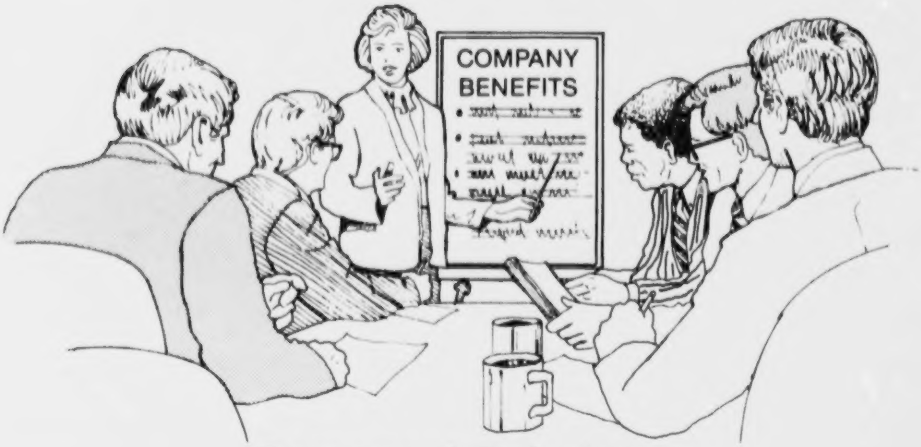
Ensuring a Positive Relationship Between Management, the Employees, and the General Public



Public Relations



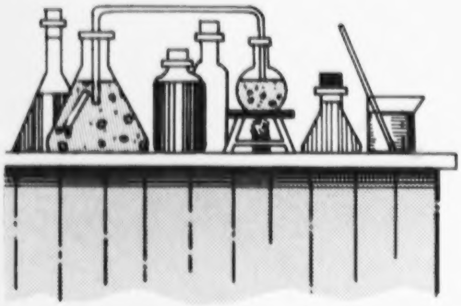
Labor Relations



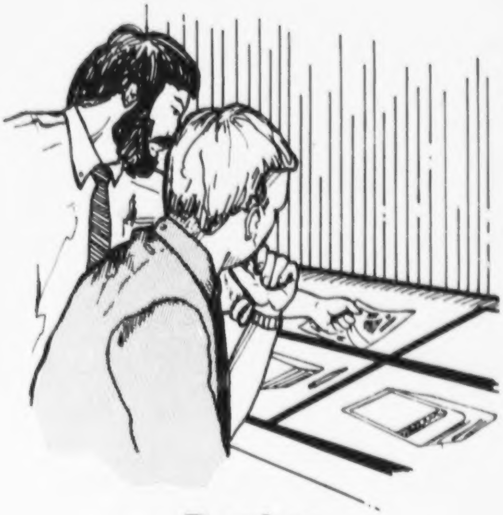
Personnel Relations

Research and Development

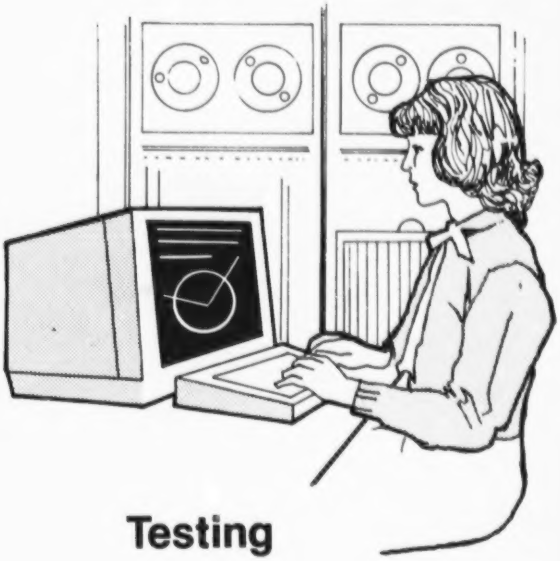
Applying Science and Technology to Create Products, Processes, and Services



Research

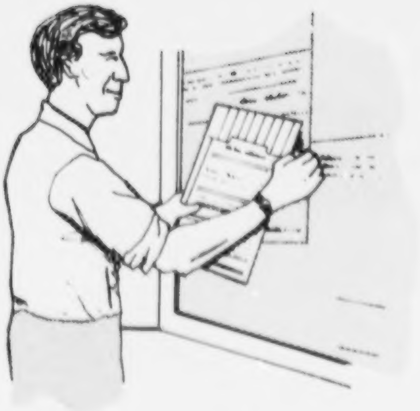


Design

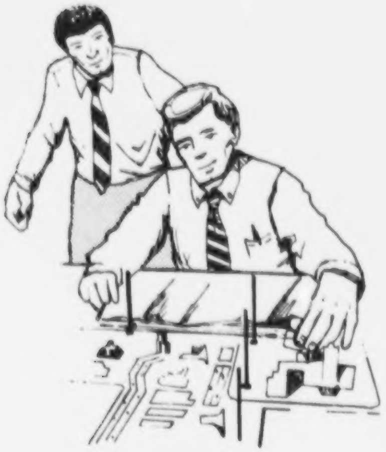


Testing

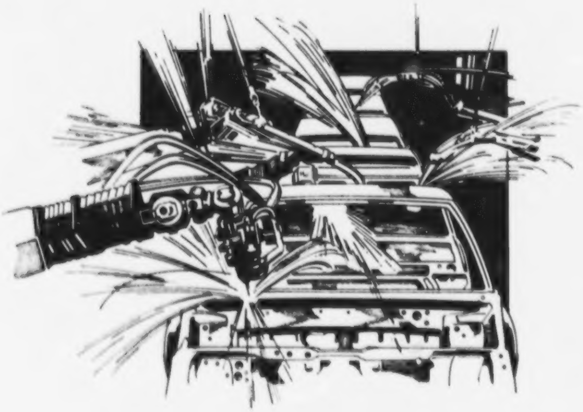
Production



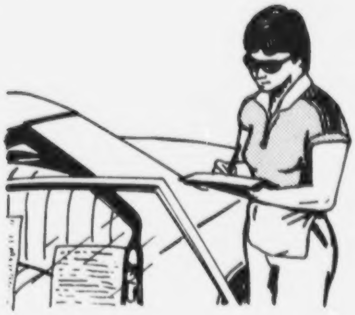
Production Planning and Control



Manufacturing and Plant Engineering



Manufacturing



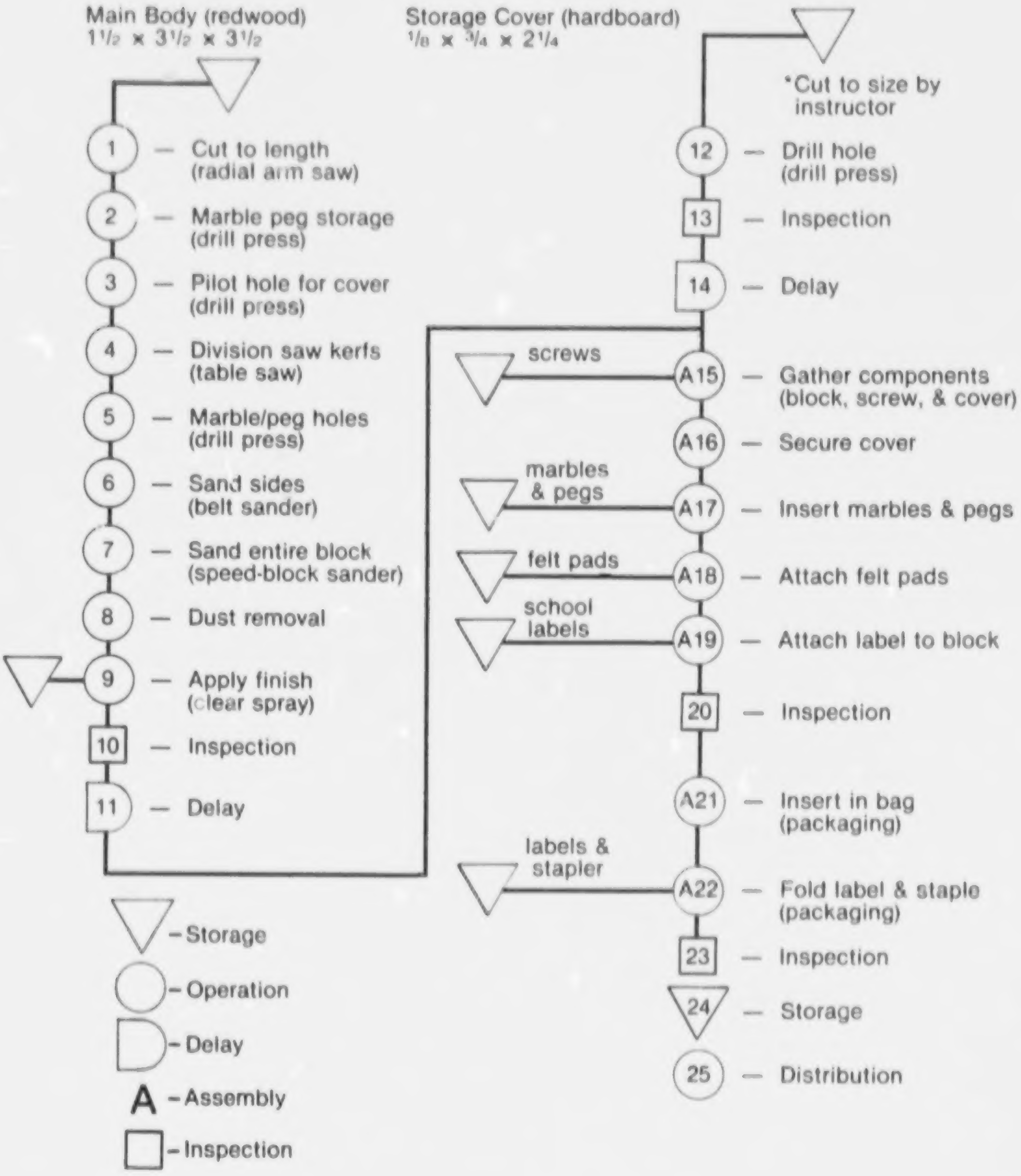
Quality Control

Marketing

Encouraging the Flow of Goods from Producer to Consumer

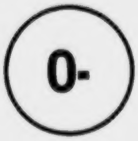
MANUFACTURING PROCESS PLANNING
UNIT V-D

HANDOUT #1 — TIC-TAC-TOE OPERATION FLOW CHART


Main Body (redwood)
1½ × 3½ × 3½
Storage Cover (hardboard)
⅛ × ¾ × 2¼
*Cut to size by instructor
1 — Cut to length (radial arm saw)
2 — Marble peg storage (drill press)
3 — Pilot hole for cover (drill press)
4 — Division saw kerfs (table saw)
5 — Marble/peg holes (drill press)
6 — Sand sides (belt sander)
7 — Sand entire block (speed-block sander)
8 — Dust removal
9 — Apply finish (clear spray)
10 — Inspection
11 — Delay
12 — Drill hole (drill press)
13 — Inspection
14 — Delay
screws
A15 — Gather components (block, screw, & cover)
A16 — Secure cover
marbles & pegs
A17 — Insert marbles & pegs
felt pads
A18 — Attach felt pads
school labels
A19 — Attach label to block
20 — Inspection
A21 — Insert in bag (packaging)
labels & stapler
A22 — Fold label & staple (packaging)
23 — Inspection
24 — Storage
25 — Distribution
- Storage
- Operation
- Delay
A - Assembly
- Inspection

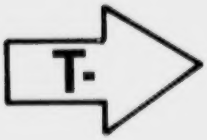
MANUFACTURING PROCESS PLANNING
UNIT V-D

HANDOUT #2 — FLOW CHART SYMBOLS



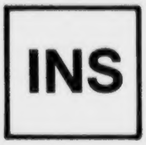
Operation

(CASTING, FORMING, SEPARATING, ASSEMBLING, CONDITIONING, FINISHING)



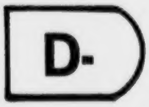
Transportation

(MOVING, CONVEYING, ETC.)



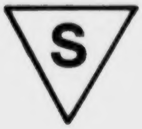
Inspection

(EXAMINING AND CHECKING QUALITY)



Delay

(STOPPING, AWAITING NEXT ACTIVITY)



Storage

(PLACING AN OBJECT IN A PROTECTED LOCATION)

MANUFACTURING PROCESS PLANNING
UNIT V-D

ASSIGNMENT SHEET #1 — DEVELOP A GUIDE FOR EVALUATING PRODUCTION WORKER PERFORMANCE

NAME ____ SCORE ____________

Directions: Develop a guide that includes several aspects of worker performance and a method of rating each aspect. Aspects could include "at work on time," "attitude," "willingness to get along with others," etc. A space for the name of the worker and the time period for the evaluation should be provided. The aspects of performance can be listed on the left of the page and the rating values on the right. One should be asked to calculate an overall rating for each worker.

Submit your form on a separate piece of clean paper.

Criteria for grading include:

Neat and legible	30%
Contains good aspects for rating	30%
Is simple and easy to use	20%
Contains some aspects not discussed in class	20%

MANUFACTURING PROCESS PLANNING
UNIT V-D

ASSIGNMENT SHEET #2 — DESCRIBE WORKER PERFORMANCE DURING A MASS PRODUCTION ACTIVITY

NAME ______________________________ SCORE ____________

Directions: If you have completed the mass production activity, complete the following questions. Neatness will constitute 10% of your grade on this activity.

A. Name ______________________________

B. Job title(s) ______________________________

____

C. Responsibilities for Job 1 ______________________________

____

Job 2 ______________________________

____

D. How could this activity have been improved? ______________________________

____

____

____

____

E. Briefly describe the performance of each of the following divisions.

1. Research and Development ______________________________

____

____

2. Finance and Accounting ______________________________

____

____

ASSIGNMENT SHEET #2

3. Production ________________________________

____

____

4. Industrial Relations ________________________

____

____

5. Marketing __________________________________

____

____

MANUFACTURING PROCESS PLANNING
UNIT V-D

NAME ______________________________ SCORE ______________________

TEST

1. Match the terms on the right with the correct definitions.

   ______a. Devices used to maintain the correct position between the workpiece and the tool during machining and assembly

   ______b. Devices used for measuring and for checking the accuracy of parts

   ______c. Diagram that indicates the order of operations as materials move through a series of processes to become a finished product

   ______d. Costs that are dependent on external conditions such as labor and materials

   1. Fixed costs
   2. Flow chart
   3. Gauges
   4. Interchangeability of parts
   5. Jigs and fixtures
   6. Overhead
   7. Variable costs

2. Match the major areas within a manufacturing organization on the right with the correct descriptions.

   ______a. Develops and prepares the product to be produced

   ______b. Provides and controls money

   ______c. Provides personnel to meet the needs of the process

   ______d. Manufactures the product

   ______e. Sells and distributes the product

   1. Finance and accounting
   2. Industrial relations
   3. Research and development
   4. Production
   5. Marketing

3. Distinguish between the basic functions of the financial affairs and accounting division of a business by placing the following letters next to the correct descriptions:

   - C — Control
   - F — Finance
   - P — Purchasing

   ______a. Buying the quantity and quality of materials, services, and equipment needed

   ______b. Maintaining records and preparing financial reports

   ______c. Obtaining sufficient operating funds and investing surplus funds

TEST

4. State the purpose of a budget used by management in a manufacturing organization.

____

____

5. Complete the following statements that describe the types of budgets and estimates that are used within manufacturing organizations by filling in the blanks correctly with the following words: Financial, sales, general expense, production expense, top level management, general workers.

   a. The ______________ budget estimates and attempts to define all expenses resulting from producing the product.

   b. The ______________ estimate projects income from data provided by market research or from previous years.

   c. The master budget is used by ______________ to develop an overall financial picture of the company.

   d. The ______________ budget is a summary of projected income and expenses for a specific time period.

   e. The ______________ budget projects expenses of maintaining a company office and operating and marketing program.

6. Distinguish between the major areas of the industrial relations area of a company by placing the following letters next to the correct descriptions:

   - PER — Personnel relations
   - LR — Labor relations
   - PUR — Public relations

   ______a. Is responsible for maintaining and improving the company's image in the eyes of the public

   ______b. Provides for hiring and firing people

   ______c. Provides for employment training, safety seminars, employee services, etc.

   ______d. Attempts to promote and maintain positive relations and attitudes between the company and the workers

TEST

7. Complete the following statements concerning the responsibilities of the research and development areas of an organization.

   a. ______________ is conducted for the purpose of discovering new knowledge.

   b. ______________ involves finding applications for the knowledge that is uncovered.

8. Complete statements describing production activities that occur within a company.

   a. Production is the activity that takes a product design generated by research and development and ______________ the product.

   b. Production may also be described as an act or process of creating or adding ______________ to materials.

9. List the four major steps that occur during the production phase of a manufacturing operation.

   a. ____

   b. ____

   c. ____

   d. ____

10. Match the functions of marketing on the right with the correct descriptions.

______a.	Communicates information about company products with the public to encourage sales	1. Market research
		2. Advertising
______b.	Moves the product from the manufacturing organization to the customer	3. Sales
______c.	Gathers, analyzes, and interprets facts and opinions concerning the marketing of products	4. Distribution
______d.	Provides an organized method for selling the company's products	

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

11. Develop a guide for evaluating production worker performance. (Assignment Sheet #1)

12. Describe worker performance during a mass production activity. (Assignment Sheet #2)

MANUFACTURING PROCESS PLANNING
UNIT V-D

ANSWERS TO TEST

1. a. 5
   b. 3
   c. 2
   d. 7

2. a. 3
   b. 1
   c. 2
   d. 4
   e. 5

3. a. P
   b. C
   c. F

4. To provide a way of estimating money needs

5. a. Production expense
   b. Sales
   c. Top level management
   d. Financial
   e. General expense

6. a. PUR
   b. PER
   c. PER
   d. LR

7. a. Research
   b. Development

8. a. Manufactures
   b. Value

9. a. Production planning and control
   b. Manufacturing and plant engineering
   c. Manufacturing
   d. Quality control

10. a. 2
    b. 4
    c. 1
    d. 3

11.-12. Evaluated to the satisfaction of the instructor

INTRODUCTION TO ENERGY, POWER, AND TRANSPORTATION
UNIT I-E

UNIT OBJECTIVE

After completion of this unit, the student should be able to distinguish between the various forms of energy and their sources, select true statements concerning the environmental impact of energy sources, and list careers available. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Distinguish between the classifications of energy.
2. Distinguish between the forms of energy.
3. Match the sources of energy with their correct descriptions.
4. List past, present, and future uses of energy.
5. Select true statements concerning environmental and economic impact of various sources of energy.
6. Name careers and their educational requirements in the energy, power, and transportation fields.
7. List personal energy needs and their sources. (Assignment Sheet #1)
8. List personal energy needs and their sources if there were no fossil fuels. (Assignment Sheet #2)
9. Research a career in energy, power, and transportation. (Assignment Sheet #3)

INTRODUCTION TO ENERGY, POWER, AND TRANSPORTATION
UNIT I-E

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Show films on energy. Refer to Suggested Supplemental Resources for possible films.
2. Invite local managers from the gas and electric companies and/or local government to discuss source of energy, proportion used in community homes, alternative energy sources, and conservation.
3. Have students bring a picture from a magazine or newspaper of an alternative energy source and make a display.
4. Group discussion of energy needs. Compare today's "needs" with those in the past and our future needs.
5. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Bohn, Ralph C., et. al. *Energy, Power, and Transportation Technology.* Peoria, IL: Bennett & McKnight, 1986.

B. Bitowski, Robert, et.al. *Power/Energy.* Baton Rouge, LA: Louisiana Department of Education, Office of Vocational Education, 1984.

C. Todd, R., et. al. *Understanding and Using Technology.* Worcester, MA: Davis Publications, Inc., 1985.

SUGGESTED SUPPLEMENTAL ACTIVITIES

A. Films:

1. "Energy: Critical Choices Ahead" (27 min. color)
   Free Loan — Texas Power and Light, Public Service Dept.
   P.O. Box 226331, Dallas, Texas 75266

2. "Energy: The American Experience" (28 min. color) #0507
   Free Loan — ERDA Film Library, Technical Education Center
   P.O. Box 62, Oak Ridge, Tennessee 37830

3. "Energy: New Sources" (20 min. color)
   University of Illinois, Film Center
   1325 South Oak Street, Champaign, IL 61820

4. "A Question of Balance" (28 min. color)
   Free Loan — Modern Talking Pictures
   1212 Avenue of the Americas, New York, NY 10036

5. "Windsong" — Video ½", color, 19 minutes, 1984.
   A historical perspective of windmills and their possible future in windpower.
   Available from:

   Centre Productions, Inc.
   1800 30th Street, #207
   Boulder, CO 80301
   1-800-824-1166

B. **Books/Handbooks**

Occupational Outlook Handbook
U.S. Department of Labor
Bureau of Labor Statistics
Washington, DC 20212

SUGGESTED SUPPLEMENTAL ACTIVITIES

C. **Videotapes (VHS or Beta)**
The following videotapes discuss the duties and training required for various careers. They are available from:

Morris Video
413 Avenue G #1
P.O. Box 443
Redondo Beach, CA
1-800-843-3603, (213) 379-2414

1. Air Transport/Flight Services, CS-170
2. Air Transport/Ground Services, CS-171
3. Marine Transport, CS-173
4. Materials Handling, CS-174
5. Materials Handling Equipment Operators, CS-175
6. Motor Transport, CS-176
7. Railroad Transport, CS-177

INTRODUCTION TO ENERGY, POWER, AND TRANSPORTATION
UNIT I-E

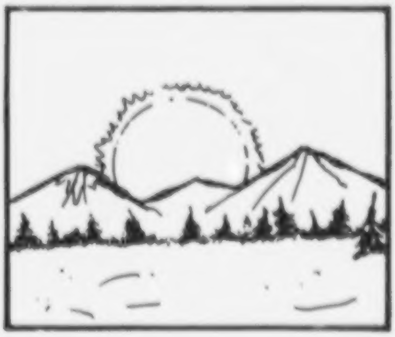
INFORMATION SHEET

I. **Classifications of energy**

A. Inexhaustible — Energy sources that will always be available

Examples: Solar, wind, and geothermal

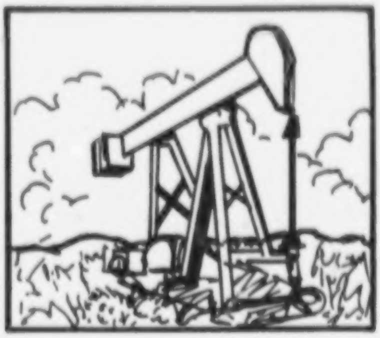
FIGURE 1



B. Exhaustible — Energy sources that cannot be replaced once they are used

Examples: Fossil fuels, nuclear energy

FIGURE 2

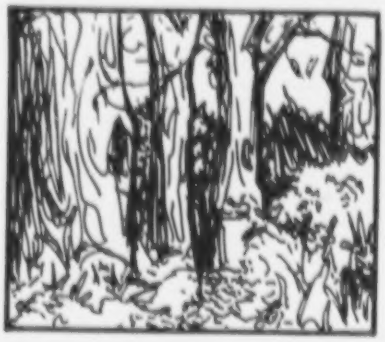


INFORMATION SHEET

C. Renewable — Energy sources that can be used indefinitely if they are properly managed and maintained

Examples: Wood, plants, and waste products

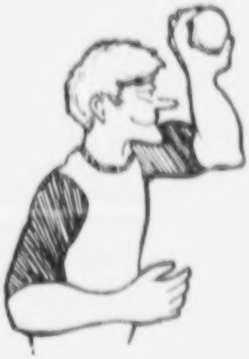
FIGURE 3



II. **Forms of energy** (Transparency 1)

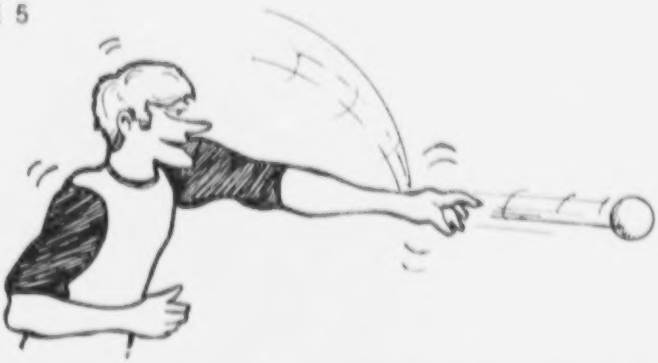
A. Potential — Energy stored, or energy ready to be used or available for use.

FIGURE 4



B. Kinetic — Energy in motion, or the ability of objects that are moving to do work.

FIGURE 5



INFORMATION SHEET

III. **Sources of energy** (Transparencies 2 and 3)

   A. Wind — Air that is in motion, such as prevailing trade winds and the jet stream

   B. Water — Wave action, flowing rivers, and the oceans

   C. Solar — Energy from the sun

   D. Geothermal — Natural heat energy from the earth's interior

   E. Fossil fuel — Fuel derived from fossilized living things, such as coal, oil, and natural gas

   F. Nuclear — Energy released when certain kinds of atoms are split

   G. Chemical — Energy that is locked away in the molecules of many kinds of substances

   H. Bioconversion — Process of obtaining energy from wastes

   Example: Methane gas from garbage

   I. Wood — Forests of the world

IV. **Past, present, and future uses of energy** (Transparency 4)

   A. Wind

      1. Wind was used in the past for transportation and to pump water and grind grain in windmills.

      2. The primary uses of wind today are for travel and to pump water and generate electricity.

      3. The greatest future use will probably be a more effective turbine for electrical production.

   B. Water

      1. Water was used in the past to grind grain, to saw wood, and for transportation.

      2. Generating electrical power, transportation, and irrigation are today's most common uses.

      3. Harnessing tidal and wave power and making them economically feasible will be this source's future.

   C. Solar

      1. The first example of using converted solar energy was the solar pump developed in the 1700's.

      2. It is used today for heating homes and producing electricity.

      3. Plans for this source include an outer space solar collector.

INFORMATION SHEET

D. Geothermal

1. Prehistoric man first used this water and heat for heating and cooking.
2. Today it is used for heating and generating electricity.
3. Utilizing this natural source to increase heating and electrical output is planned for this source.

E. Fossil fuels

1. The earliest uses were for heating and lighting and later for transportation.
2. Today's uses of this energy source include heating, cooking, transportation, and electricity generation.
3. Decreased usage of this fuel will occur primarily due to depletion of a nonrenewable source.

F. Nuclear

1. Until a practical formula, $E = mc^2$, was invented by Einstein and proven in 1942, this source of energy was only theory.
2. Research, electricity generation, and transportation are the primary uses of this source today.
3. The future of this source lies with improved and safer reactors.

G. Chemical

1. Explosives used in China in the 1600's and alcohol fermentation are two of the earliest uses of chemical energy.
2. Fuel cells, explosives, heating, and transportation (batteries) are among the more common uses for this source.
3. Explosives and transportation (battery-powered vehicles) will be in the future for this source.

H. Bioconversion

1. This source of energy has a very recent past. It first was used in the 1960's for heating buildings and generating electricity.
2. Today this is a source for alcohol fuel, sale of solid waste, and steam.
3. Increased efficiency in using waste materials will be important in the future.

INFORMATION SHEET

I. Wood

1. The earliest uses were for heat, light, and weapons.
2. Today this is used for production of heat, light, and many paper products.
3. This could become a future source of fuel for automobiles (methanol alcohol).

V. **Environmental and economic effects of energy** (Transparency 5)

A. Wind

1. When used to produce energy, it has no harmful effect on the environment.
2. It is an unpredictable energy source and availability cannot be controlled; therefore, it is a useful energy source in only certain areas of the world.

B. Water

1. The loss of prime farm land and wildlife habitat are some of the environmental effects in using hydroelectric energy.
2. Tides and the thermal action of oceans could provide additional sources of energy as soon as technology makes it economically feasible.

C. Solar

1. This source of energy is similar to wind in that it has no harmful effect on the environment.
2. The present technology does not permit economical use of this source of energy on a large scale.

D. Geothermal

1. Environmental effects include heat, waste products, and unknown contaminants.
2. Using geothermal energy is economical but it is limited to areas of high geothermal activity.

E. Fossil fuels

1. Fossil fuels present the greatest threat to the environment in the form of air and water pollutants.
2. Presently it is the cheapest form of energy but this can change when it becomes scarce.

INFORMATION SHEET

F. Nuclear

1. Radiation fallout, spills and disposal of waste present the greatest problems in using this form of energy.
2. High cost of installation and problems with approval make this form of energy economically unattractive.

G. Chemical

1. Environmental problems include water, air, and land pollution.
2. Research and development are needed to make chemical energy economically efficient.

   Example: Fuel cells to power automobiles

H. Bioconversion

1. Reduction in volumes of garbage and wastes help reduce environmental problems associated with disposal.
2. Energy generated from wastes is economically beneficial.

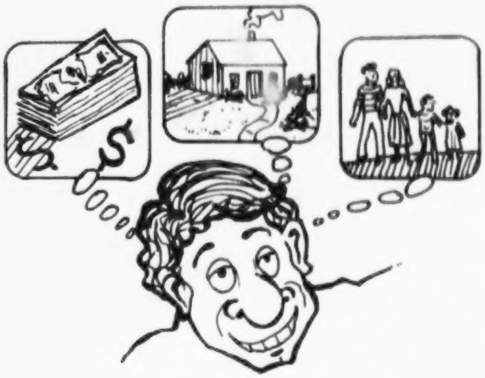
I. Wood

1. It is not a clean-burning fuel and creates high levels of air pollution.
2. Now being used to offset high energy cost of heating homes.

VI. Careers and educational requirements in energy, power, and transportation fields

(NOTE: Your choice of a career will be one of the most important decisions you will ever make. You can expect to spend ¼ of your life at work. As you explore a career, you need to think about a long term commitment that would include your interests and abilities in that profession.)

FIGURE 6



Your values are important no matter what you do. Avoid careers that conflict with the things you consider important.

INFORMATION SHEET

(NOTE: The careers mentioned are only a few of the hundreds possible.)

A. Generation of electricity
   1. Engineer — 1
   2. Plant supervisor — 2,4,5,6
   3. Technician — 2,3,4,5,6

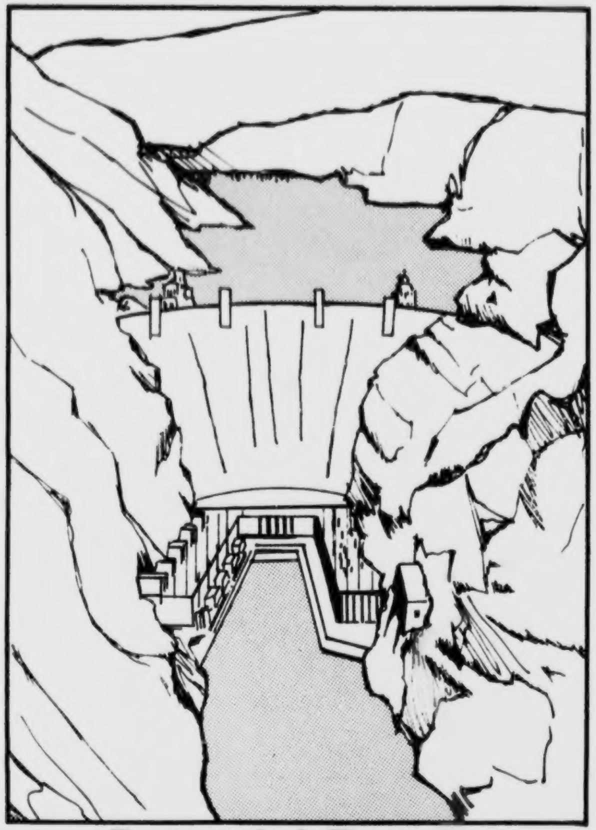
B. Energy exploration and research
   1. Engineer — 1
   2. Geologist — 1,2
   3. Chemist — 1,2
   4. Surveyor — 1,2
   5. Cartographer (map-maker) — 4,5.6

C. Transportation
   1. Air traffic controller — 2,3,4,5,6
   2. Truck dispatcher — 2,3,4,5,6
   3. Airplane pilot — 2,4
   4. Railroad engineer — 2,4
   5. Flight engineer — 2,4
   6. Truck driver — 2,4

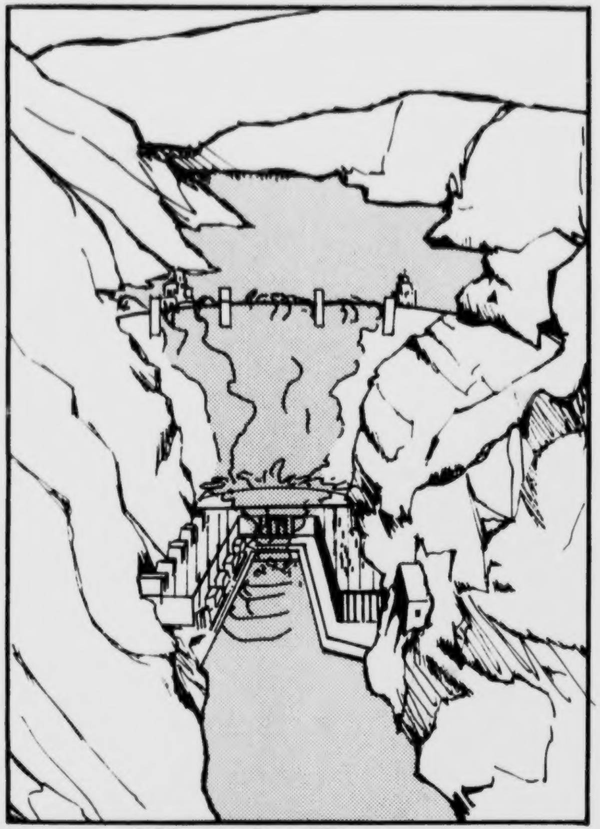
D. Conservation and the environment
   1. Environmental control specialist — 1,2,5
   2. Conservation specialist — 1,2,5
   3. Chemist — 1,2
   4. Scientist — 1,2

1. College degree
2. On-the-job training
3. Apprenticeship
4. Specialized technical training (Armed Services, F.A.A., etc.)
5. Junior College
6. Vo-Tech School

Forms of Energy

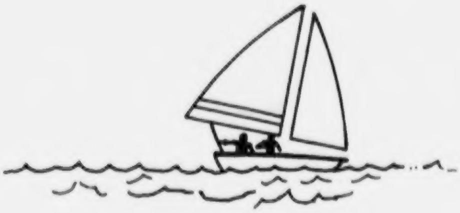


Potential Energy
(Energy Stored)
Water Behind a Dam

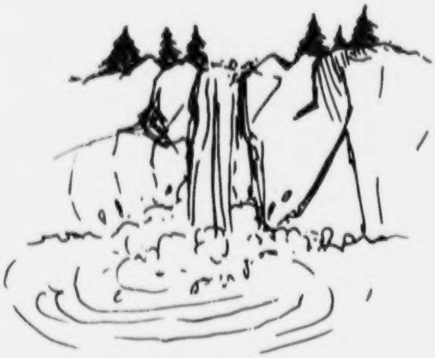


Kinetic Energy
(Energy in Motion)
Water Released From a Dam

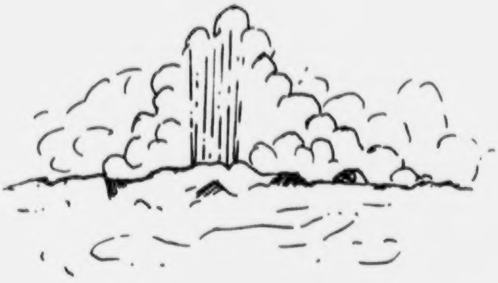
Sources of Energy



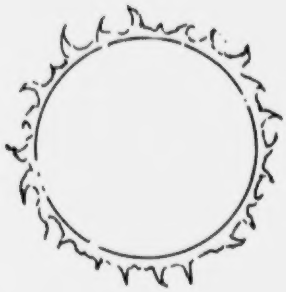
Wind



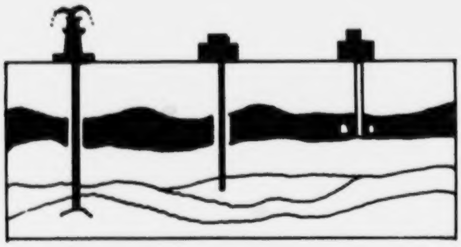
Water



Geothermal



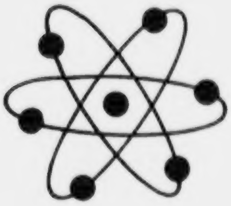
Solar



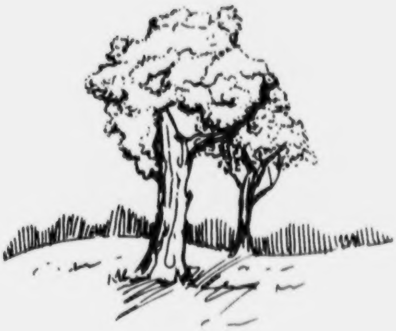
Fossil Fuels

Sources of Energy

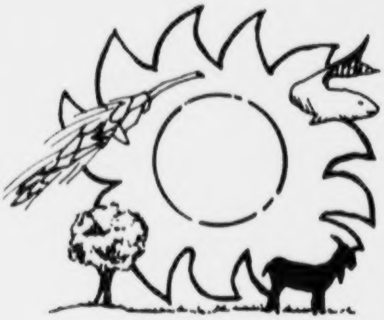
(Continued)



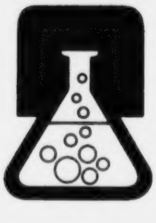
Nuclear



Wood



Bioconversion

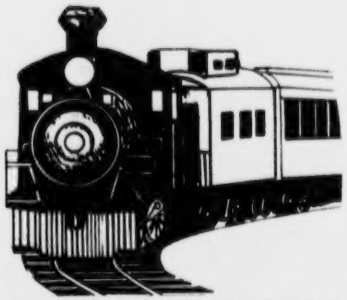


Chemical

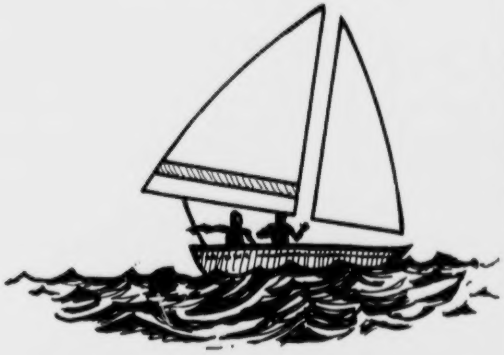
Past, Present, and Future Uses of Energy

(Example of Transportation Shown)

Past

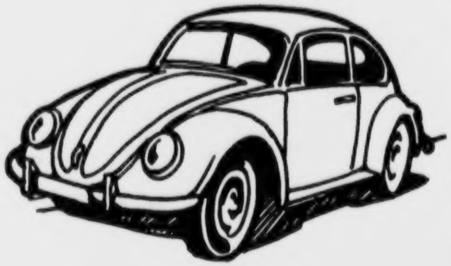


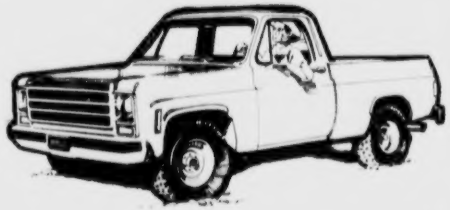
(Powered by Wood or Coal and Water [Steam])



(Powered by Water and Wind)

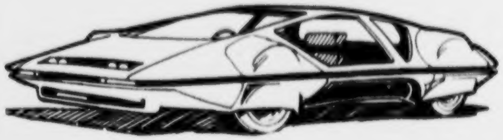
Present



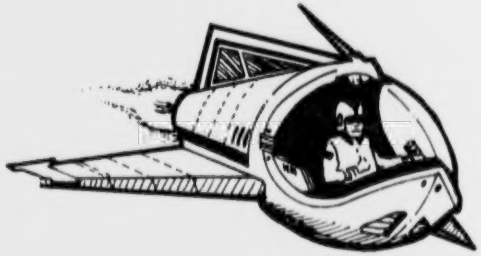


(Powered by Gasoline Engines)

Future

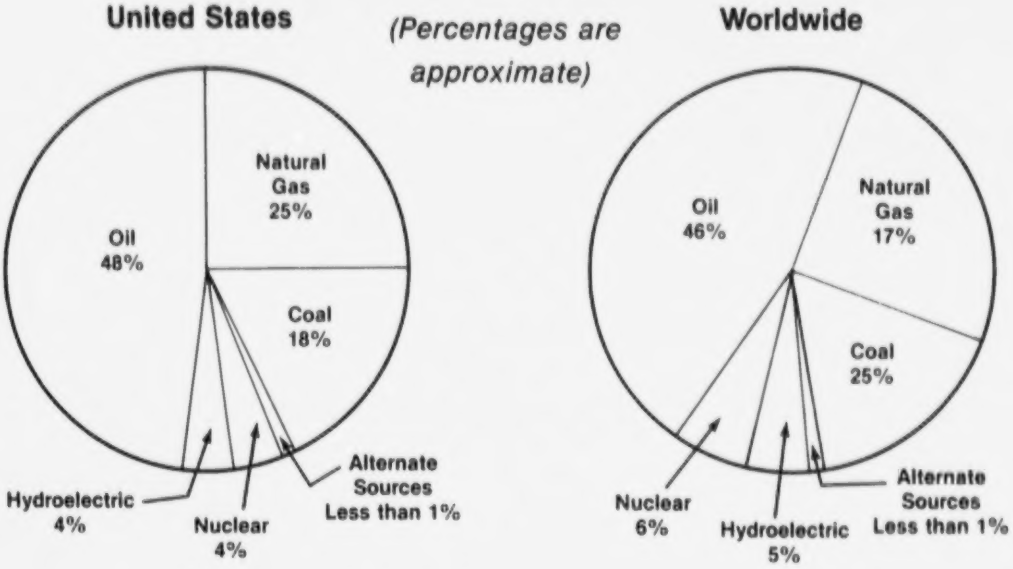


(Battery-Powered)

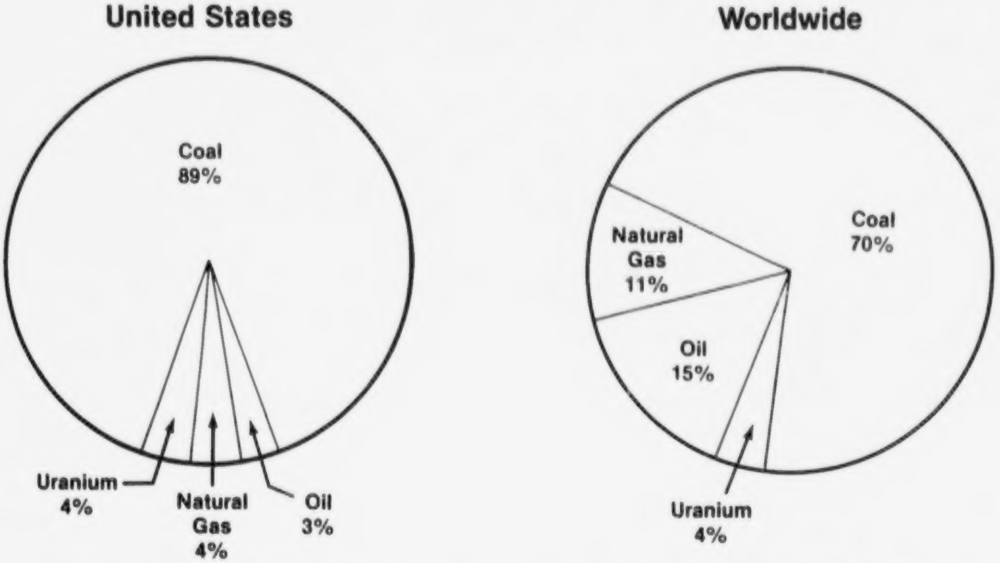


(Solar-Powered)

Energy Usage and Reserves



Usages — These are what are presently being used



Reserves — These are what are available

Notice that our most used source of energy is oil, but it is in short supply.

INTRODUCTION TO ENERGY, POWER, AND TRANSPORTATION
UNIT I-E

ASSIGNMENT SHEET #1 — LIST PERSONAL ENERGY NEEDS AND THEIR SOURCES

NAME______________________________________ SCORE ____________

Think about all the energy demands and uses that apply to your personal needs during the past 24 hours. *List* the ways you have used energy in your daily life. For example: transportation, entertainment, communication, cooking, and hygiene. Give as many examples in each category as you can.

Energy Used For:	Source of Energy
Hygiene	
Food	
Transportation	
Entertainment and Communication	

INTRODUCTION TO ENERGY, POWER, AND TRANSPORTATION
UNIT I-E

ASSIGNMENT SHEET #2 — LIST PERSONAL ENERGY NEEDS AND THEIR SOURCES IF THERE WERE NO FOSSIL FUELS

NAME____________________________________ SCORE ____________

Think about all the energy demands and uses that apply to your personal needs during the past 24 hours. List the ways you have used energy in your daily life. Then discuss what would happen if tomorrow there were no fossil fuels to use as a source to meet your energy needs.

Energy Used For:	Alternate Source of Energy
Hygiene	
Food	
Transportation	
Entertainment and Communication	

INTRODUCTION TO ENERGY, POWER, AND TRANSPORTATION
UNIT I-E

ASSIGNMENT SHEET #3 — RESEARCH A CAREER IN ENERGY, POWER, AND TRANSPORTATION

NAME ______________________________ SCORE __________

Directions: Examples of careers were discussed in the Information Sheet, Section VI. You may be able to name other careers. Select a career you are interested in and think you could do well. Research for details. Resource materials are available in the Laboratory/Classroom. You may also contact the school counselor and/or librarian. The *Occupational Outlook Handbook* is a good source.

1. What is the exact training needed?
2. Where can you get that training?
3. What are the working conditions for that job?
4. What are the future possibilities for employment?
5. Why would you be good at that job?

Compile the results of your research and present in an oral or written report as requested by your instructor.

INTRODUCTION TO ENERGY, POWER, AND TRANSPORTATION
UNIT I-E

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheets #1-#3 — Evaluated to the satisfaction of the instructor

INTRODUCTION TO ENERGY, POWER, AND TRANSPORTATION
UNIT I-E

NAME ______________________________ SCORE __________

TEST

1. Distinguish between the correct classifications of energy by placing inexhaustible, exhaustible, and renewable in the proper blanks.

    a. ____________ — Energy sources that can be used indefinitely if they are properly managed and maintained

    b. ____________ — Energy sources that cannot be replaced once they are used

    c. ____________ — Energy sources that will always be available

2. Distinguish between the forms of energy by placing a "P" for Potential or a "K" for Kinetic in the proper blanks.

    _____a. Energy in motion, or the ability of objects that are moving to do work

    _____b. Energy stored, or energy ready to use or available for use

3. Match the energy sources on the right with the correct descriptions.

    _____a. Energy from the sun

    _____b. Wave action, flowing rivers, and oceans

    _____c. Energy that is locked away in the molecules of many kinds of substances

    _____d. Fuel derived from fossilized living things

    _____e. Air that is in motion

    _____f. Process of obtaining energy from wastes

    _____g. Natural heat energy from the earth's interior

    1. Fossil fuels
    2. Geothermal
    3. Wood
    4. Wind
    5. Bioconversion
    6. Solar
    7. Nuclear
    8. Water
    9. Chemical

TEST

4. List past, present, and/or future uses of the following energy sources.

    a. How was wind used in the past?

    b. How is water used today as an energy source?

    c. How may solar energy be used today and in the future?

    d. What does the future use of fossil fuels look like?

    e. How may chemical energy be used in the future?

5. Select true statements concerning economic and environmental effects of energy by placing a "T" next to the true statements and an "F" next to the false statements.

______a. Wood is clean-burning and creates very little air pollution.

______b. Fossil fuels are the cheapest forms of energy, but are a great threat to the environment.

______c. Wind has no harmful effects, but it is an unpredictable source of energy.

______d. Geothermal energy is cheap, and it can be found anywhere in the world.

______e. Environmental problems of chemical energy include water, air, and land pollution, but it can be used to power cars.

______f. Radiation fallout, spills and disposal of waste present the greatest problems in using nuclear energy.

TEST

______g. Energy generated from wastes helps reduce the volume of garbage but it is not economically sound.

______h. The loss of prime farm land and wildlife habitat are some of the environmental effects in using hydro-electric energy.

______i. Solar energy is now used on a large scale because it is so cheap to install and use.

6. Name a career and educational requirement for the following areas.

   a. Generation of electricity

   ____

   ____

   b. Energy exploration and research

   ____

   ____

   c. Transportation

   ____

   ____

   d. Conservation and the environment

   ____

   ____

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.

7. List personal energy needs and their sources. (Assignment Sheet #1)

8. List personal energy needs and their sources if there were no fossil fuels. (Assignment Sheet #2)

9. Research a career in energy, power, and transportation. (Assignment Sheet #3)

INTRODUCTION TO ENERGY, POWER, AND TRANSPORTATION
UNIT I-E

ANSWERS TO TEST

1. a. Renewable
   b. Exhaustible
   c. Inexhaustible

2. a. K
   b. P

3. a. 6
   b. 8
   c. 9
   d. 1
   e. 4
   f. 5
   g. 2

4. Answers may vary. Evaluate to satisfaction of instructor. Discussion may include:
   a. Wind was used in the past for transportation and to pump water and grind grain in windmills.
   b. Water is used today for generating electrical power, transportation, and irrigation.
   c. Solar energy is used today and probably will be used in the future for heating homes and producing electricity.
   d. Fossil fuels will be used less in the future primarily due to depletion.
   e. Chemical energy may be used in the future for explosives and transportation.

5. a. F
   b. T
   c. T
   d. F
   e. T
   f. T
   g. F
   h. T
   i. F

ANSWERS TO TEST

6. Any one from each of the following:
   a. Generation of electricity
      1) Engineers — 1
      2) Plant supervisor — 2,4,5,6
      3) Technician — 2,3,4,5,6
   b. Energy exploration and research
      1) Geologist · 1,2
      2) Chemist — 1,2
      3) Surveyor — 1,2
      4) Cartographer (mapmaker) — 4,5,6
      5) Engineer — 1
   c. Transportation
      1) Air traffic controller — 2,3,4,5
      2) Truck dispatcher — 2,3,4,5,6
      3) Airplane pilot — 2,4
      4) Railroad engineer — 2,4
      5) Flight engineer — 2,4
      6) Truck driver — 2,4
   d. Conservation and the environment
      1) Environmental control specialist — 1,2,5
      2) Conservation specialist — 1,2,5
      3) Chemist — 1,2
      4) Scientist — 1,2

1. College degree
2. On-the-job training
3. Apprenticeship
4. Specialized technical training (Armed Services, F.A.A.)
5. Junior College
6. Vo-Tech School

7.—9. Evaluated to the satisfaction of the instructor

ENERGY/POWER CONVERSION AND MEASUREMENT

UNIT II-E

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify energy conversions, solve problems measuring energy and power, and build a simple electric motor and solar cooker. Competencies will be demonstrated by completing the assignment sheets, job sheets, and unit tests with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to energy/power conversion and measurement with the correct definitions.
2. Match forms of energy with the correct descriptions.
3. Complete statements concerning characteristics of energy.
4. Distinguish between the types of conversions.
5. Distinguish between the types of combustion engines.
6. Distinguish between energy and power.
7. Arrange in order the stages of the basic power theory.
8. Complete statements concerning the measurement of energy and power.
9. Identify types of energy used in converting one form of energy into another. (Assignment Sheet #1)

OBJECTIVE SHEET

10. Solve problems calculating work, horsepower, and torque. (Assignment Sheet #2)

11. Demonstrate the ability to:

    a. Build a simple electric motor. (Job Sheet #1)

    b. Build a solar cooker. (Job Sheet #2)

ENERGY/POWER CONVERSION AND MEASUREMENT
UNIT II-E

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Provide students with job sheets.

H. Discuss and demonstrate the procedures outlined in the job sheets.

I. Integrate the following activities throughout the teaching of this unit:

1. Show films on energy. Refer to Suggested Supplemental Resources for possible films.

2. Perform an experiment to measure human power as compared to horsepower.

3. Demonstrate the production of electrical energy through the use of magnetism.

4. Demonstrate the production of electricity through the use of chemical energy.

(NOTE: Experiments for activities 2-4 above are outlined in the University of Texas materials as referenced on the next page. You may also refer to science catalogs for prepared experiments on energy conversion and measurements.)

5. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

J. Give test.

K. Evaluate test.

L. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Bame, E. Allen, and Paul Cummings. *Exploring Technology.* Worcester, Massachusetts: Davis Publications, Inc., 1980.

B. Bitowski, Robert, et. al. *Power/Energy.* Baton Rouge, Louisiana 70804: Louisiana Department of Education, Office of Vocational Education, 1984.

C. Bohn, Ralph C., et. al. *Energy, Power, and Transportation Technology.* Peoria, Illinois: Bennett & McKnight, 1986.

D. Groneman, Chris H. and John L. Feirer. *General Industrial Education and Technology.* 7th ed. New York: McGraw-Hill, 1986.

E. Heiner, Carl W. and Wayne R. Hendrix. *People Create Technology.* Worcester, Massachusetts: Davis Publications, Inc., 1980.

F. Pershing, Rex W. *Energy and Power.* Des Moines, Iowa: Department of Public Instruction, Career Education Division, 1980.

G. Smith, Howard Bud, ed. *Exploring Energy: Sources/Applications/Alternatives.* South Holland, Illinois: Goodheart-Willcox Company, Inc., 1985.

H. *Systems of Technology.* Austin, TX: EIMC, The University of Texas at Austin, 1986.

I. Towler, Alan L. *Power Systems.* Austin, TX: Texas Education Agency, Division of Continuing Education, 1983.

SUGGESTED SUPPLEMENTAL RESOURCES

A. **Films**

1. *Your Place in the Nuclear Age* (20 min. color) #0A52
   ERDA Film Library
   Technical Information Center
   P.O. Box 62
   Oak Ridge, TN 37838

2. *Here Comes the Sun* (15 min. color) #0499
   ERDA Film Library
   Technical Information Center
   P.O. Box 62
   Oak Ridge, TN 37838

3. *Power* (19 min. color)
   University of Illinois
   Visual Aids Service
   1325 South Oaks Street
   Champaign, IL 61820

B. **Catalogs**

Edmund Scientific
101 East Gloucester Pike
Barrington, NJ 08007

ENERGY/POWER CONVERSION AND MEASUREMENT
UNIT II-E

INFORMATION SHEET

I. **Terms and definitions**

   A. Armature — A type of electromagnet in which the core is not movable

   B. Commutator — A device or strip of curved metal used to convey current from the armature to the brushes

   C. Conversion — The process of changing from one form to another

   D. Electromagnet — An iron core wrapped with a current-carrying coil of wire

   E. Hydrox cell — A type of fuel cell that provides steady current across its terminal to drive electrical motors

   F. Photovoltaic — Devices that convert sunlight directly into electricity

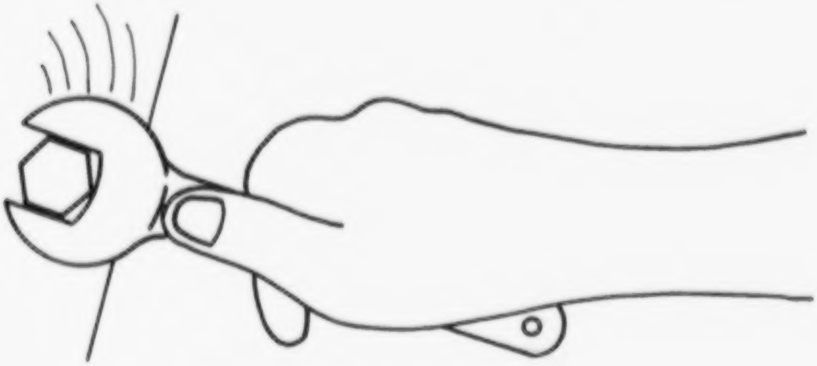
   G. System model — An organized way of doing a job or task

   H. Magnetism — The property which enables certain metals and metallic oxides to attract other metals

II. **Forms of energy** (Transparency 1)

   A. Mechanical energy — The energy of motion, the most common and visible form of energy

   Example: The mechanical energy of this moving wrench is used to turn a nut.



INFORMATION SHEET

B. Heat (thermal) energy — The motion of atoms or molecules. The faster they move, the more heat they produce.

(NOTE: Heat is present whenever there is motion.)

Example: The movement of a hot air balloon is a visible effect of thermal energy. The "fuel" for the balloon is the heated air. As the hot air rises, so does the balloon.

C. Light energy — The visible part of radiant energy consists of electromagnetic waves traveling through space

D. Chemical energy — Energy produced by chemical changes; the source of energy for all living things

E. Electrical energy — The motion of tiny invisible particles of matter called electrons

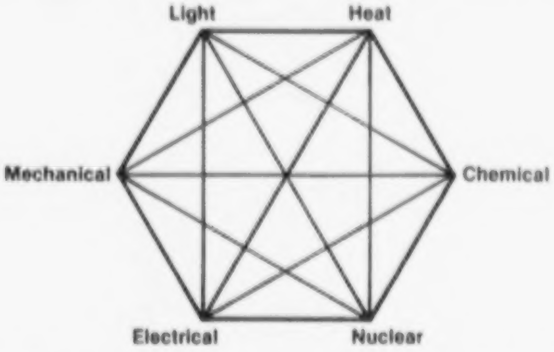
F. Nuclear energy — Energy produced by reactions in the nuclei of atoms

III. **Characteristics of energy** (Transparency 2)

A. Energy, generally, cannot be created or destroyed.

(NOTE: When we say energy is being used, it is not being used up or destroyed. It still exists in some state or form.)

B. Energy can be converted from one form to any other form.



1. We are usually trying to convert potential (stored) energy (such as chemical or nuclear fuels) into kinetic (moving) energy (such as mechanical or electrical energy).

2. We commonly use generating plants and various types of engines to make these energy conversions.

3. Examples of conversions include

   a. Exercise — Chemical energy (food) converts to mechanical energy (motion) and thermal energy (heat).

INFORMATION SHEET

b. Photoelectric cells — Sun (light energy) converts to electricity (electric energy).

c. Electric generating plant — Chemical energy (fuel) converts to heat energy when burned which is applied to water to produce steam (mechanical energy) which drives a turbine (mechanical energy) which operates a generator which converts energy to electricity (electrical energy) which travels to a home to operate a light bulb (light energy).

d. Electric stove — Supplied electrical energy converts to heat energy

e. Flashlight battery — Chemical energy converts to electrical energy to light energy

IV. **Types of conversions**

A. Direct conversion — When energy is used after only one conversion

Example: Solar cells convert sunlight directly into electricity

B. Indirect conversion — When several conversions must take place before the energy is in the right form to do work.

Example: Automobiles engines convert fuel (chemical energy) into heat energy for combustion then into mechanical energy to move gears and wheels; may also be converted to electrical energy then to light energy by headlights.

V. **Types of combustion engines** (Transparency 3)

A. Internal combustion engine (heat)

1. Is designed to vaporize and burn a mixture of air and fuel enclosed in a chamber called a cylinder.

2. Piston in cylinder may use two strokes or four strokes to complete a power cycle.

Example: Gasoline and diesel engines

B. External combustion engine

1. The heat energy is produced outside of the engine.

2. Fuel such as oil or coal is used for heat energy.

3. Gas, after being pressurized by heat, is then used inside the engine to drive the pistons or turbines.

Example: Steam engine, Stirling engine

INFORMATION SHEET

VI. **Definitions of energy and power** (Transparency 4)

A. Energy — Capacity to do work (potential energy) or the accomplishment of work (kinetic energy)

B. Power — Rate at which energy is used — Work divided by time

(NOTE: For example, you must use a certain amount of *energy* to ride a bicycle. The energy you use will be the same whether you go slow or fast. However, the amount of *power* used is different. The faster you go, the more power you use because power is tied to the amount of time used.)

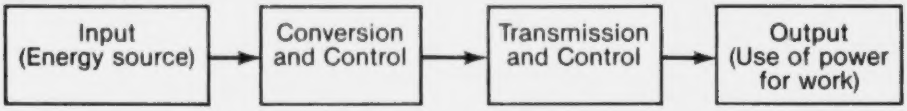
VII. **Stages of the basic power theory** (Transparency 5)

A. Input

B. Conversion and control

C. Transmission and control

D. Output

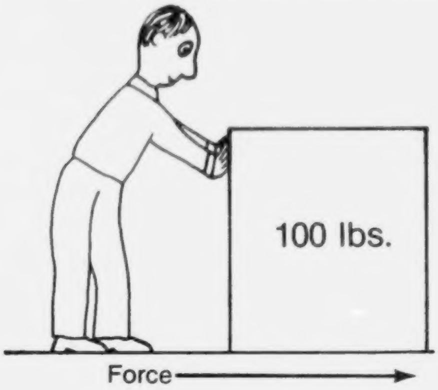

Input
(Energy source)
Conversion
and Control
Transmission
and Control
Output
(Use of power
for work)

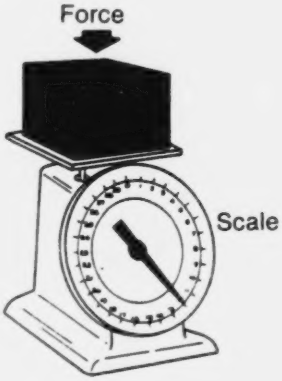
VIII. **Measuring energy and power**

(NOTE: As people learned to control energy, they developed ways to measure energy and power. By using measurements we can find out how much energy we need to perform a task.)

A. Force

1. Definition: Any push or pull on an object


100 lbs.
Force


Force
Scale

(NOTE: Weight is force applied in a vertical [up and down] direction.)

INFORMATION SHEET

2. Units of measurement

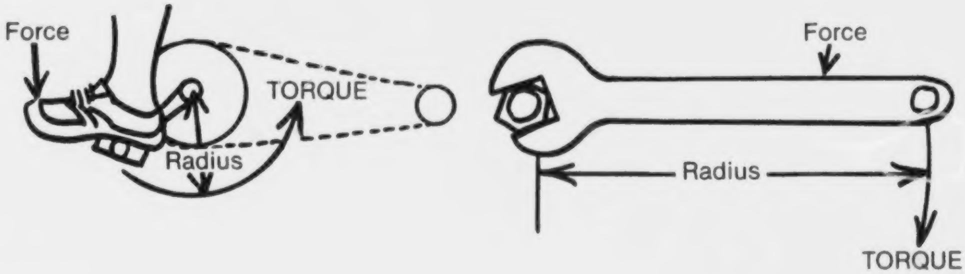
   a. U.S. standard — Pounds

   b. Metric — Newtons

B. Torque

1. Definition: Turning or twisting effort

2. Formula: Torque = Force (lbs) × Radius (ft)


Force
TORQUE
Radius
Force
Radius
TORQUE

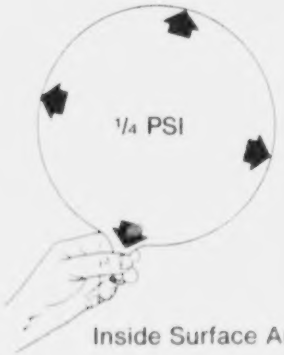
3. Units of measurement

   a. U.S. standard — Pound-feet

   b. Metric — Newton-meters

C. Pressure

1. Definition: Force per unit of area



Inside Surface Area = 100 sq. in.

INFORMATION SHEET

2. Formulas: Area = Length × Width

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

3. Units of measurement

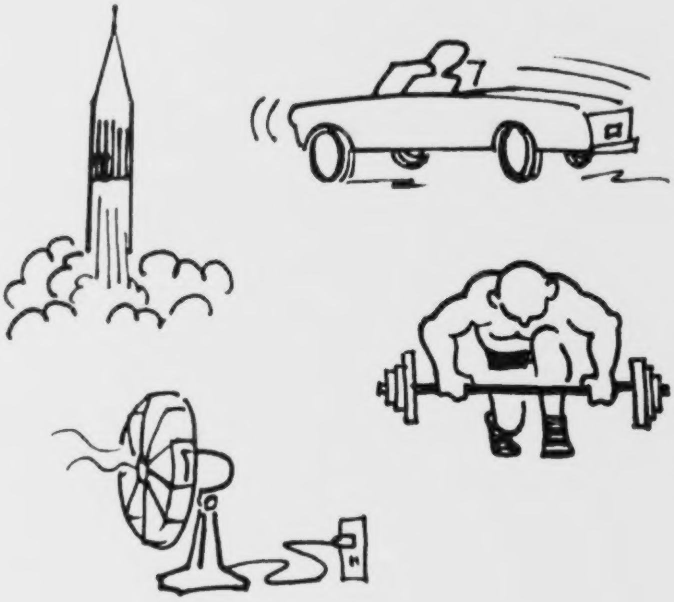
   a. U.S. standard — Pounds per square inch (psi)

   b. Metric — Pascals (Pa) or Kilopascals (kPa)

   (NOTE: Units of pressure are normally used to measure the force exerted by fluids [gases or liquids].)

D. Work

1. Definition: Useful motion or motion that results in something useful being done; measurement of mechanical energy



Examples: Movement of a vehicle, movement of boxes

(NOTE: There is no work if nothing is accomplished. If you tried to move a boulder and could not move it at all, you have not performed any work. You may have exerted energy, but you did not perform any work because there was no useful motion.)

2. Formula: Work = Force (in pounds) × Distance (in feet)

INFORMATION SHEET

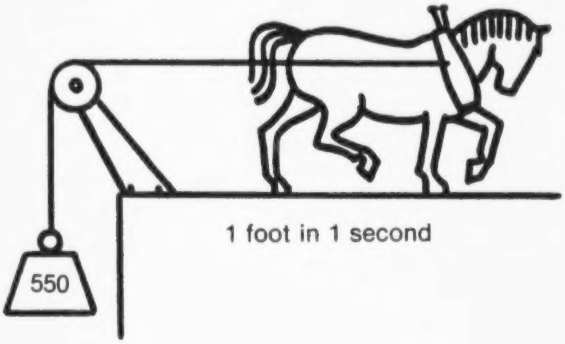
3. Units of measurement

   a. U.S. standard — foot-pounds (ft.-lbs)

   b. Metric — joules (j)

E. Horsepower

1. Definition — The unit of measure for power. One hp equals the energy needed to lift 550 lbs. 1 foot in 1 second, or 33,000 lbs. 1 foot in 1 minute.



2. Formulas —

$$\frac{\text{Force} \times \text{Distance}}{\text{Time (in seconds)} \times 550} \quad \text{or}$$

$$\frac{\text{Force} \times \text{Distance}}{\text{Time (in minutes)} \times 33{,}000}$$

3. Units of measurement

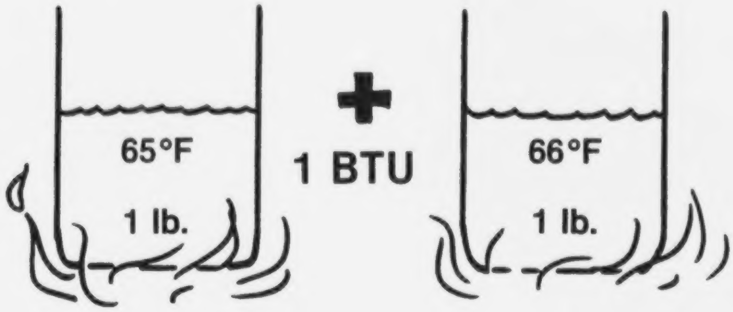
   a. U.S. standard — horsepower (hp)

   b. Metric — watt (w)

INFORMATION SHEET

F. British thermal units (BTUs)

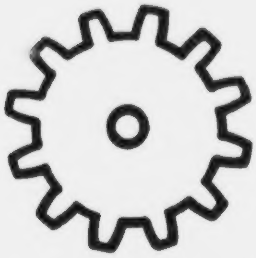
1. Definition: The heat needed to raise the temperature of 1 pound (0.45 kg) of water 1 degree Fahrenheit (0.56°C)



2.

Units of measurement	Heat energy	Heat power
a. U.S. Standard	BTU	BTU per second
b. Metric	Joule and calorie	watt

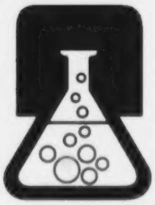
Forms of Energy



Mechanical

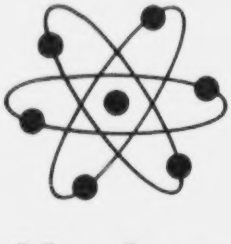
Heat

Light



Chemical

Electrical

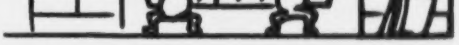


Nuclear

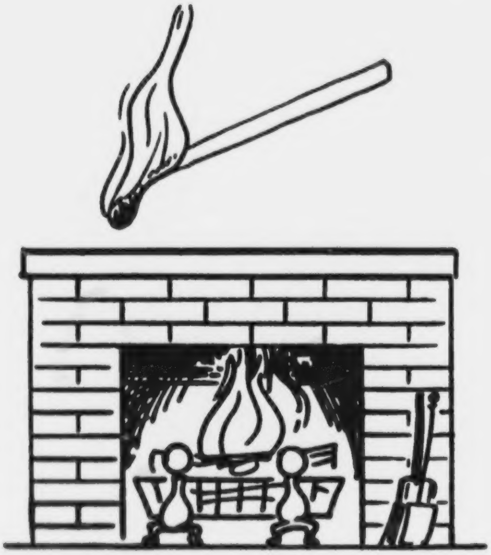
Characteristics of Energy

— Energy Cannot be Created or Destroyed.

— It Can Only Be Changed From One Form to Another.



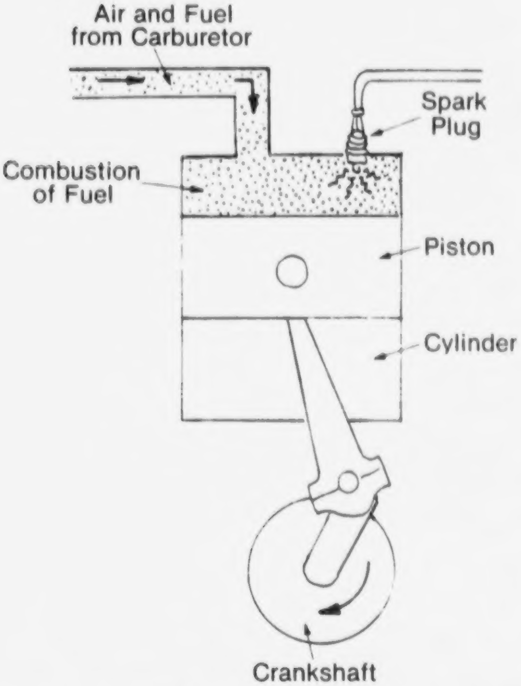
Potential Energy



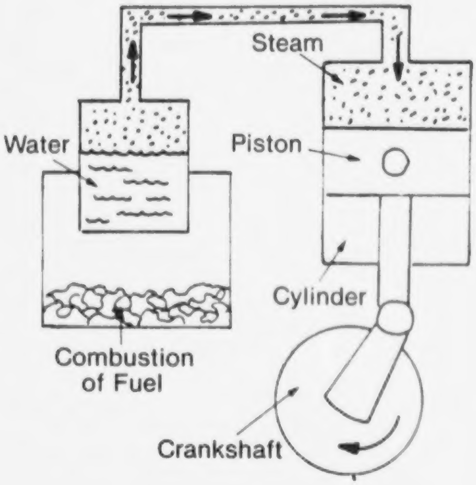
Kinetic Energy

In this example wood represents potential energy in the form of chemical energy. When ignited, it changes to kinetic energy and gives off heat energy and light energy.

Types of Combustion Engines

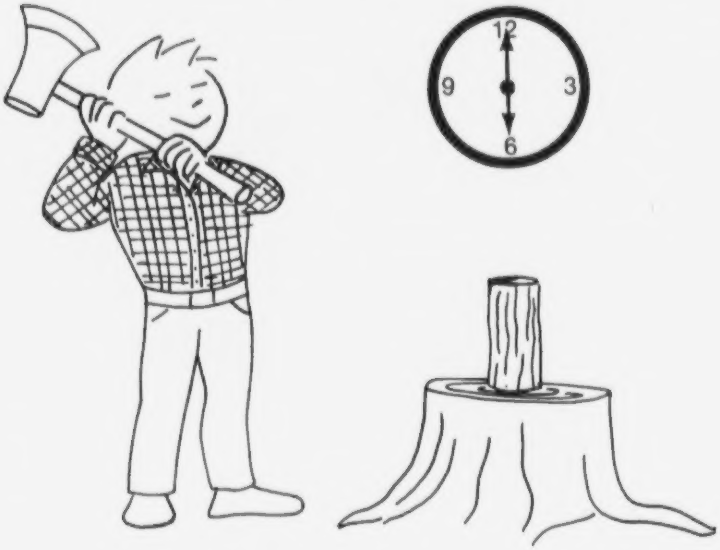

Air and Fuel
from Carburetor
Spark
Plug
Combustion
of Fuel
Piston
Cylinder
Crankshaft

Internal Combustion Engine

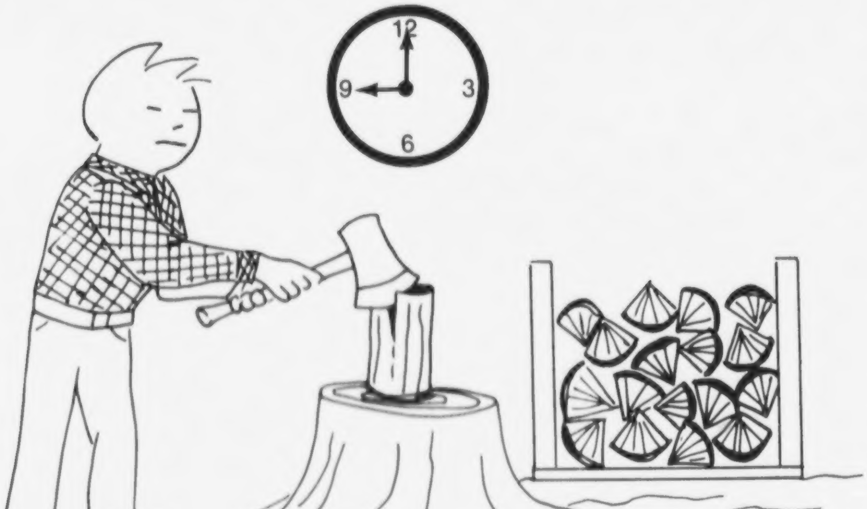

Steam
Water
Piston
Cylinder
Combustion
of Fuel
Crankshaft

External Combustion Engine

Energy and Power



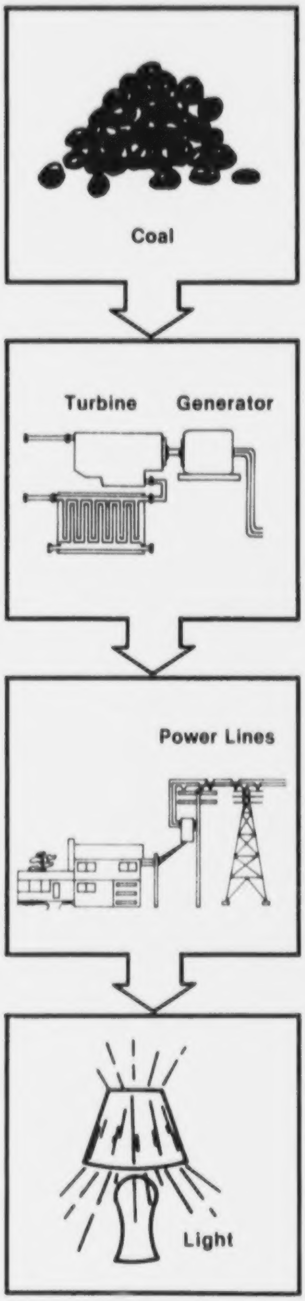
Energy — Capacity to Do Work or the Accomplishment of Work



Power — Rate at Which Energy Is Used

Stages of Power Theory

(Example of Electrical Power Shown)


Coal
Turbine
Generator
Power Lines
Light

Input

Conversion

Transmission

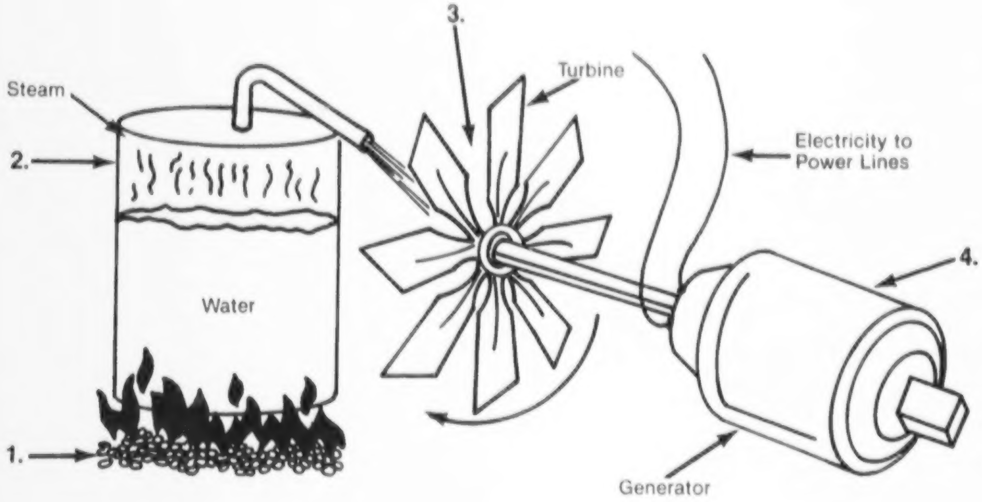
Output

ENERGY/POWER CONVERSION AND MEASUREMENT
UNIT II-E

ASSIGNMENT SHEET #1 — IDENTIFY TYPES OF ENERGY USED IN CONVERTING ONE FORM OF ENERGY INTO ANOTHER

NAME ____ SCORE ____________

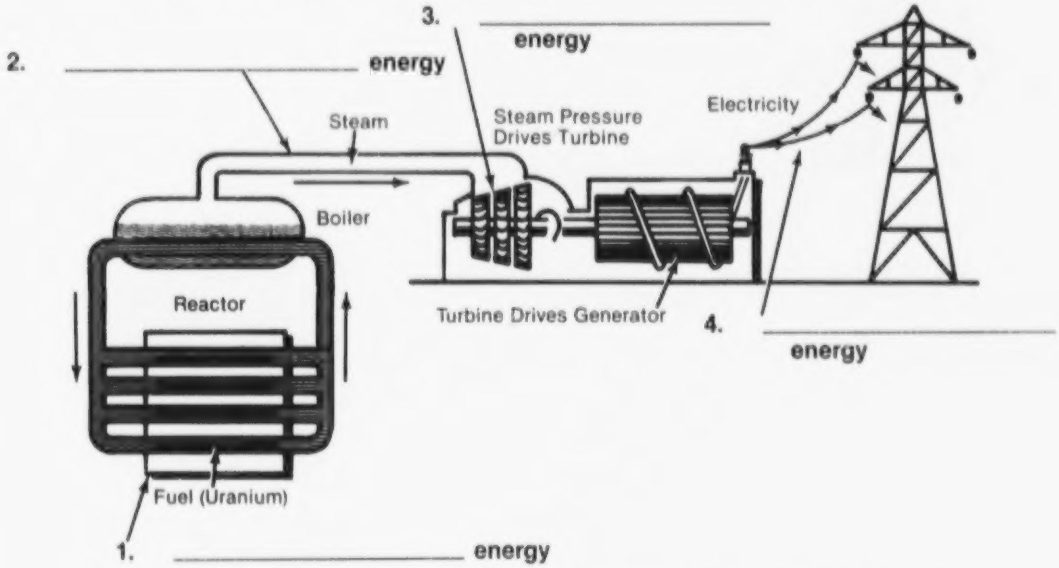
A. Identify types of energy used in converting one form of energy into another.


3.
Turbine
Steam
2.
Electricity to Power Lines
4.
Water
1.
Generator

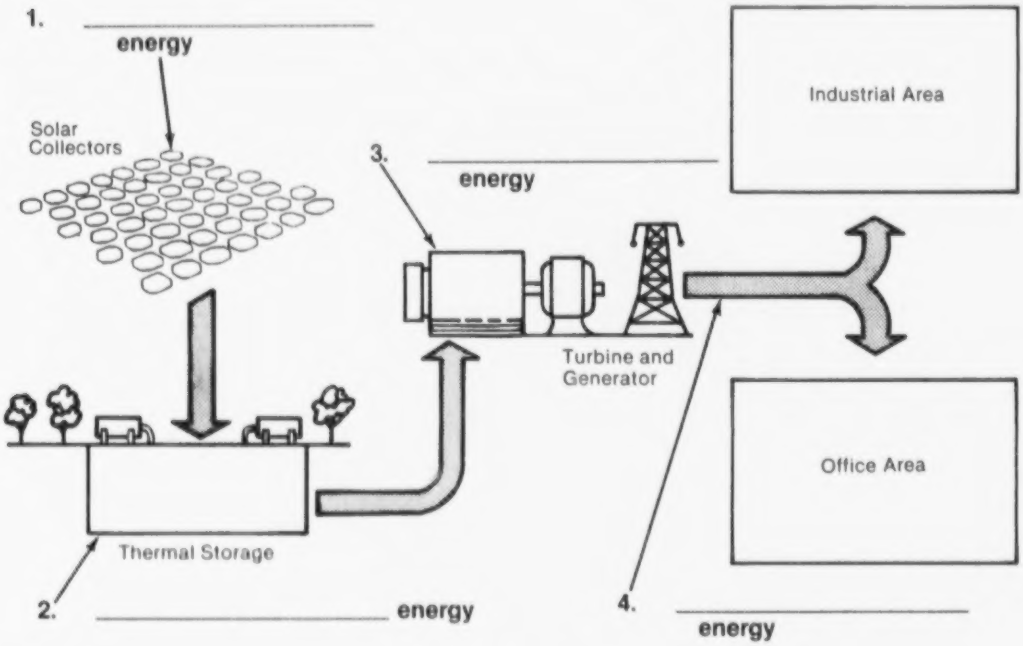
1. ____________ energy in the fuel converts to 2. ____________ energy to convert water to steam. It converts to 3. ____________ energy to spin the turbine. The turbine drives the generator which converts it to 4. ____________ energy.

ASSIGNMENT SHEET #1

B. Identify types of energy used in converting one form of energy to another.


3. ____________ energy
2. ____________ energy
Steam
Steam Pressure Drives Turbine
Electricity
Boiler
Reactor
Turbine Drives Generator
4. ____________ energy
Fuel (Uranium)
1. ____________ energy

C. Identify types of energy used in converting one type of energy to another.


1. ____________ energy
Solar Collectors
3. ____________ energy
Industrial Area
Turbine and Generator
Office Area
Thermal Storage
2. ____________ energy
4. ____________ energy

ENERGY/POWER CONVERSION AND MEASUREMENT
UNIT II-E

ASSIGNMENT SHEET #2 — SOLVE PROBLEMS CALCULATING WORK, HORSEPOWER, AND TORQUE

NAME ______________________________ SCORE __________

A. Formulas

1. Work = Force × Distance

2. Horsepower = $\dfrac{\text{Force} \times \text{Distance}}{\text{Time (in seconds)} \times 550}$

or

$$\frac{\text{Force} \times \text{Distance}}{\text{Time (in minutes)} \times 33{,}000}$$

3. Torque = Force × Radius

B. Problems

(NOTE: Round answers to nearest hundredth.)

1. What is the torque if a force of 25 pounds is applied to a wheel 30 inches in diameter?

   Answer: ______________________________

2. It takes 55 pounds of force to move a 200 pound box 20 feet across the floor. How much work is accomplished?

   Answer: ______________________________

3. If a force of 20 pounds is applied to a wrench 8 inches long, how much is the torque?

   Answer: ______________________________

4. A 125-pound woman climbs a 40 foot flight of stairs in 20 seconds. How much power does she develop performing the task?

   Answer: ______________________________

ASSIGNMENT SHEET #2

5. How much work is accomplished if it takes 100 pounds of force to move a 350 pound object 12 feet?

   Answer: ____

6. A 2-ton weight is moved a distance of 50 feet across the floor. The force necessary to move the weight is 200 pounds and the time required is two minutes. How much power is required to perform this task?

   Answer: ____

ENERGY/POWER CONVERSION AND MEASUREMENT
UNIT II-E

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

A. 1. Chemical
   2. Heat
   3. Mechanical
   4. Electrical

B. 1. Nuclear
   2. Heat
   3. Mechanical
   4. Electrical

C. 1. Solar
   2. Heat
   3. Mechanical
   4. Electrical

Assignment Sheet #2

1. 375 lb.-ft.

2. 1100 ft.-lbs.

3. 160 lb.-ft.

4. .45 hp

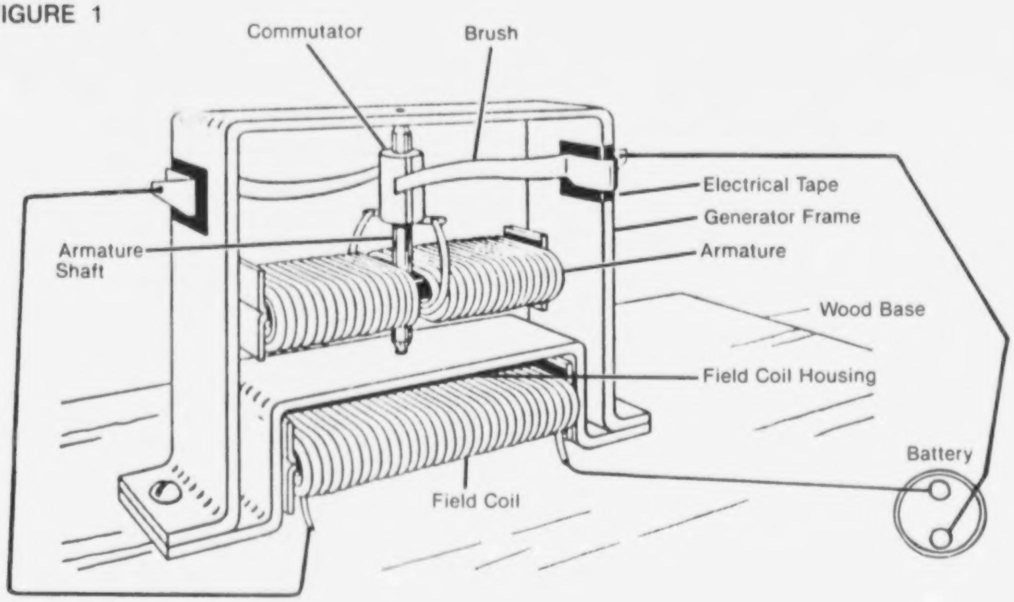
5. 1200 ft.-lbs.

6. .15 hp

ENERGY/POWER CONVERSION AND MEASUREMENT
UNIT II-E

JOB SHEET #1 — BUILD A SIMPLE ELECTRIC MOTOR

FIGURE 1


Commutator
Brush
Electrical Tape
Generator Frame
Armature Shaft
Armature
Wood Base
Field Coil Housing
Battery
Field Coil

A. Materials

1. Aluminum sheet (14 to 18 gauge)
2. 8d (or 16d) nail
3. #24 coated wire
4. Copper or brass strip (6mm wide)
5. Copper foil
6. Solder — rosin core
7. Electrician's tape
8. Wood base (2 cm × 10 cm × 10 cm)
9. Round head wood screws
10. Battery

JOB SHEET #1

11. Household cement/epoxy

12. Galvanized sheet steel (24 to 28 gauge)

B. Tools

1. Soldering iron

2. Sheet metal tools (shear and bar fold) *if available

3. Tin snips

4. Hand drill and bits

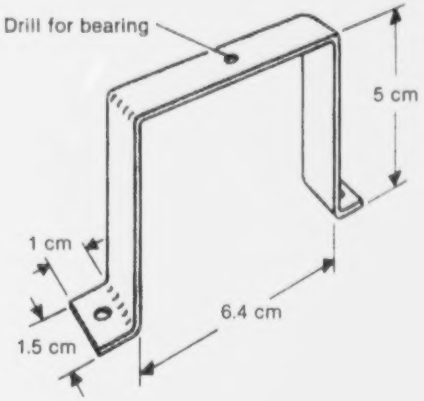
C. Procedure

1. Cut and shape metal parts as shown in illustrations. (Figure 2-5)

    a. Bend generator frame and drill for bearing.

    FIGURE 2

    (NOTE: The hole size for bearing hole (Figure 2) needs to be large enough to serve as a bearing for commutator shaft.)



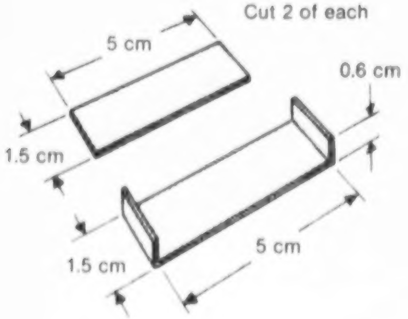
GENERATOR FRAME

14 to 18 gauge aluminum

JOB SHEET #1

b. Cut and bend field coil core.

FIGURE 3


5 cm
0.6 cm
1.5 cm
1.5 cm
5 cm

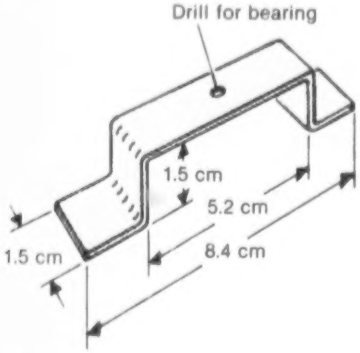
Cut 2 of each

FIELD COIL CORE

24 to 28 gauge galvanized sheet iron

c. Bend field coil housing and drill for bearing.

FIGURE 4

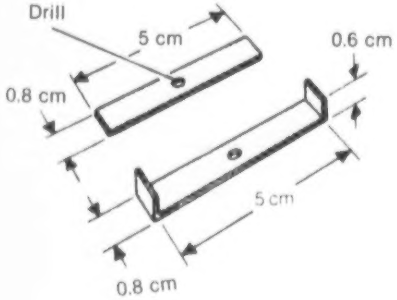

Drill for bearing
1.5 cm
5.2 cm
1.5 cm
8.4 cm

FIELD COIL HOUSING

14 to 18 gauge aluminum

d. Cut, bend, and drill armature.

FIGURE 5


Drill
5 cm
0.6 cm
0.8 cm
5 cm
0.8 cm

ARMATURE

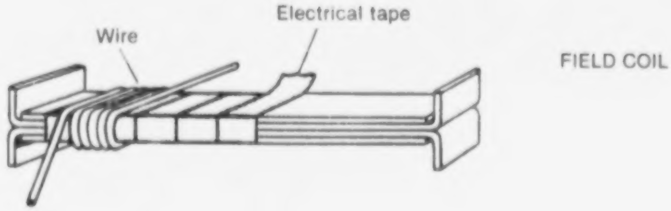
24 to 28 gauge galvanized sheet iron

Cut 2 of each

JOB SHEET #1

2. Assemble field coil. (Figure 6)

FIGURE 6



   a. Remove sharp edge from all metal pieces.

   b. Assemble metal pieces and wrap with electric tape.

   c. Wrap five layers of coated wire over electric tape, winding slowly, carefully, and in the same direction.

   d. Test completed field coil by attaching a dry cell to the two ends of the wire coil and checking with a compass.

   e. Does the compass needle line up with the length of the coil? If so, proceed.

3. Assemble armature.

   a. Remove sharp edges from metal pieces.

   b. Assemble pieces and wrap with electric tape.

   c. Place shaft in center of assembly.

   d. Wrap armature beginning at the center, leaving several centimeters of wire for later use.

   e. Wind carefully from the shaft to the end and back again to the center.

   f. Repeat, placing four layers of wire on the one side of the shaft.

   g. Cross over to the other side of the shaft without breaking the wire, and wind, going from center to end.

   h. Repeat, adding four layers of wire.

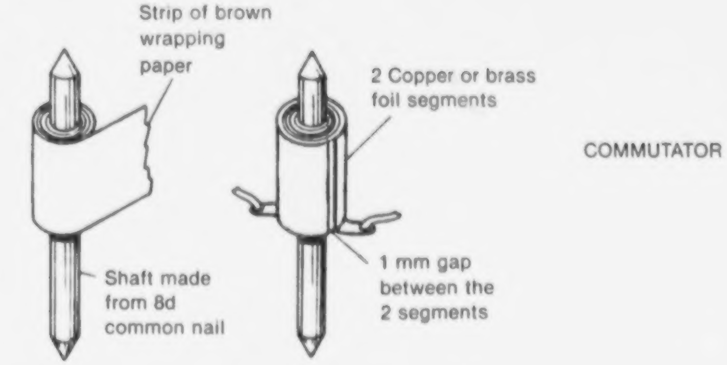
   i. Leave 2 cm. of wire at the end for later use.

   j. Test armature (step 2.d.)

JOB SHEET #1

4. Make commutator. (Figure 7)

FIGURE 7


Strip of brown wrapping paper
2 Copper or brass foil segments
COMMUTATOR
Shaft made from 8d common nail
1 mm gap between the 2 segments

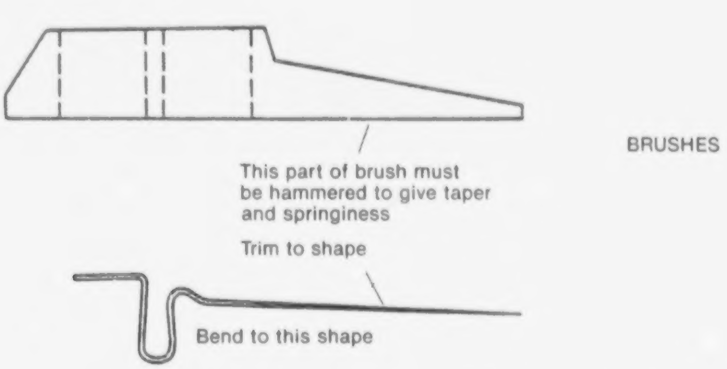
   a. Wrap brown craft paper (1 cm. wide) around the shaft until a cylinder about 7 mm in diameter is formed. Coat with household cement while wrapping to prevent paper from slipping and provide firm surface for brushes to run on.

   b. Add commutator segments made from copper foil shaped around a pencil when glue dries.

   c. Leave tabs where wires from coil can be soldered.

5. Make brushes. (Figure 8)

FIGURE 8


BRUSHES
This part of brush must be hammered to give taper and springiness
Trim to shape
Bend to this shape

   a. Cut 2 brushes from 22 or 24 gauge copper or brass according to pattern.

   b. Hammer the tip of the brush to give taper and springiness.

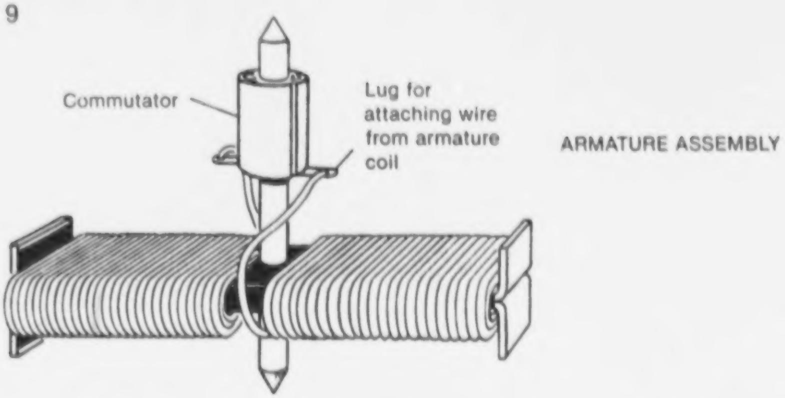
   c. Trim brushes to shape.

   d. Bend brushes to shape.

JOB SHEET #1

6. Assemble armature assembly.

FIGURE 9



a. Place the shaft of the commutator in the center of armature.

b. Shaft must fit snugly. If it is necessary, solder or epoxy shaft to armature to prevent slippage.

c. Remove enamel coating from ends of wires.

d. Solder wires to commutator tabs.

7. Attach field coil to field coil housing. (See Figure 1)

8. Attach armature and generator frame to field coil housing.

9. Fasten total assembly to base. Spin the armature. If binding occurs, free pressure by bending frame so top is moved off of shaft.

10. Clip brushes onto frame, placing electrical tape underneath for insulation so that the brushes rub lightly on commutator segments.

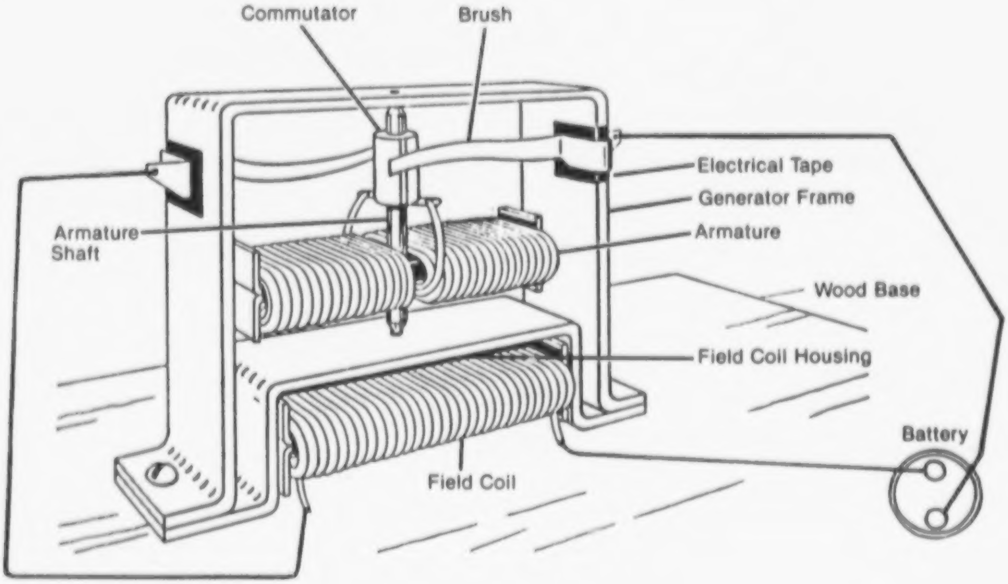
11. Connect one brush to a lead from the field coil.

12. Connect the other brush and field-coil lead to the binding posts of the cell.

JOB SHEET #1

13. Test motor.

FIGURE 10


Commutator
Brush
Electrical Tape
Generator Frame
Armature
Armature Shaft
Wood Base
Field Coil Housing
Battery
Field Coil

ENERGY/POWER CONVERSION AND MEASUREMENT
UNIT II-E

JOB SHEET #2 — BUILD A SOLAR COOKER

A. Tools and materials

1. Materials

   a. 2 feet of 1 × 4 clear pine for uprights

   b. 2½ feet of 1 × 6 clear pine for side pieces

   (NOTE: ¾" plywood could be substituted for clear pine.)

   c. 2 feet of 1 × 10 clear pine for base

   d. Two 2½ inch × ¼" bolts with wing nuts

   e. Four washers to fit bolts

   f. One 16 × 18 inch piece of reflective sheet aluminum

   g. Two dozen ½ inch aluminum brads

   h. Two "L" braces

   i. Four pan head screws (#8 × ¾")

2. Tools

   a. Hand drill and bits

   b. Back saw

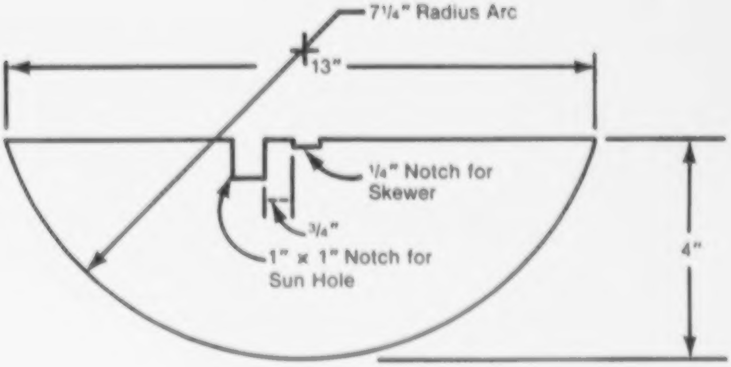
   c. Try square

JOB SHEET #2

B. Procedure

1. Build reflector unit. (Figure 1)

FIGURE 1



(NOTE: The teacher can make a template of the circle for student use.)

a. Mark and cut curved side pieces.

b. Clamp side pieces together and sand and plane to shape.

c. Bend aluminum, working carefully to avoid creasing it, to fit the curve of the side pieces. Mirror finish may be protected by taping tissue paper over it during assembly.

d. Clamp side pieces 18" apart on a level surface with curved edges up.

e. Use brads to tack aluminum to side pieces.

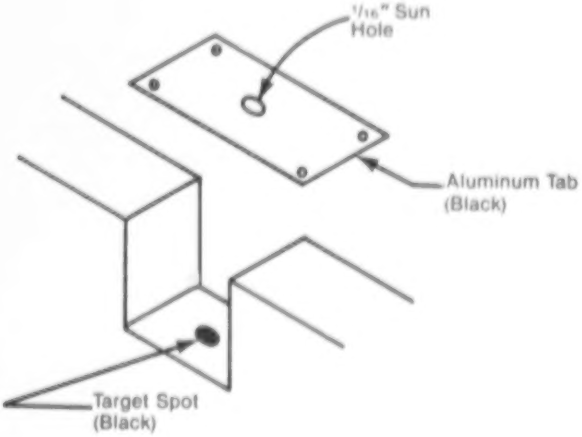
f. Follow given dimensions precisely for shape of side pieces and spit holes to assure proper focus.

g. Notch both side pieces, ¼" × ¼" notch in center. Notches should be square to hold skewer in place.

JOB SHEET #2

h. Cut a 1" × 1" notch in the left side of cooker for alignment, ¾" up from skewer notch.

FIGURE 2


1/16" Sun Hole
Aluminum Tab (Black)
Target Spot (Black)

i. Make ⅛" black dot in center, bottom of notch for a target spot.

j. Cut aluminum tab (¾" × 2") and drill 1/16" hole for sun.

k. Drill 1/32" holes in corners for brads and paint black.

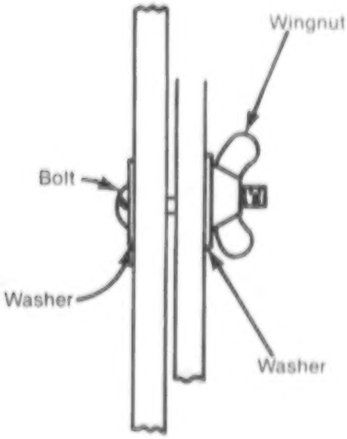
2. Make cooker assembly.

   a. Cut uprights (12" per side).

   b. Drill holes in side pieces and uprights. Clamp and drill at the same time.

   c. Attach cooker to uprights using bolts, washers, and wing nuts. (Figure 3)

FIGURE 3


Wingnut
Bolt
Washer
Washer

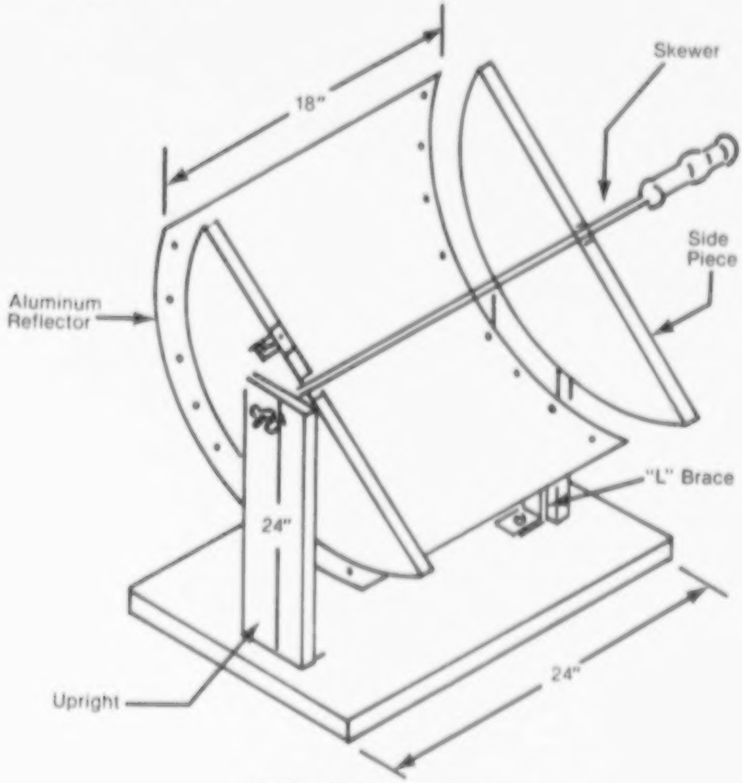
JOB SHEET #2

d. Set uprights/cooker on base, mark holes; remove.

e. Drill holes where marked.

f. Replace on holes and assemble.

FIGURE 4


18"
Skewer
Side Piece
Aluminum Reflector
"L" Brace
24"
24"
Upright

Solar Cooker Assembly

3. Test cooker.

   a. Point reflector directly at the sun.

   b. Maintain by tilting and positioning from time to time.

   c. Use sun alignment hole to determine proper angle. When sun rays hit directly on target spot, it is in alignment.

   d. Check alignment on a sunny day; adjust by shifting aluminum tab.

   e. Wrap food in aluminum foil, dull side out, to enhance heat buildup and keep grease from dripping.

JOB SHEET #2

4. Test for solar cooker efficiency

   a. Place a baby food jar full of water (4 oz.) on the center of the skewer. Attach by wire or set on a large washer taped to skewer with electrical tape.

   b. Check water temperature before starting experiment and at five-minute intervals recording the temperature.

   c. Set up a control for the experiment by placing another baby food jar (same size and water amount) on the ground close to the cooker.

   d. Check control jar at 5-minute intervals for temperature and record.

   e. Compare temperature of control and experimental jars taken at the same 5-minute intervals.

ENERGY/POWER CONVERSION AND MEASUREMENT
UNIT II-E

PRACTICAL TEST
JOB SHEET #1 — BUILD A SIMPLE ELECTRIC MOTOR

STUDENT'S NAME ______________________ DATE __________

EVALUATOR'S NAME ______________________ ATTEMPT NO. ______

Instructions: When you are ready to perform this task, ask you instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:	YES	NO
1. Checked out proper tools and materials.	______	______
2. Cut and shaped metal parts.	______	______
3. Assembled and tested field coil.	______	______
4. Assembled and tested armature.	______	______
5. Made commutator.	______	______
6. Made brushes.	______	______
7. Assembled armature assembly.	______	______
8. Assembled field core, field core housing, generator frame, and armature.	______	______
9. Connected brush to field core lead and tested motor.	______	______
10. Checked in/put away tools and materials.	______	______
11. Cleaned the work area.	______	______
12. Used proper tools correctly.	______	______
13. Performed steps in a timely manner (___hrs. ___min. ___sec.)	______	______
14. Practiced safety rules throughout procedure.	______	______
15. Provided satisfactory responses to questions asked.	______	______

EVALUATOR'S COMMENTS: ____

____

PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

Metal parts	4 Meets Requirements	3 Minor Adjustment	2 Major Adjustment	1 Replace Part
Field Coil	4 Operable	3 Minor Adjustment	2 Major Adjustment	1 Non-operable
Armature	4 Operable	3 Minor Adjustment	2 Major Adjustment	1 Non-operable
Motor	4 Operable	3 Minor Adjustment	2 Major Adjustment	1 Non-operable

EVALUATOR'S COMMENTS: ____

____

PERFORMANCE EVALUATION KEY

4 — Skilled — Can perform job with no additional training.
3 — Moderately skilled — Has performed job during training program; limited additional training may be required.
2 — Limited skill — Has performed job during training program; additional training is required to develop skill.
1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

ENERGY/POWER CONVERSION AND MEASUREMENT
UNIT II-E

PRACTICAL TEST
JOB SHEET #2 — BUILD A SOLAR COOKER

STUDENT'S NAME ______________________________ DATE ____________

EVALUATOR'S NAME ______________________________ ATTEMPT NO. ______

Instructions: When you are ready to perform this task, ask you instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:	YES	NO
1. Checked out proper tools and materials.	______	______
2. Marked and cut side pieces of reflector unit; planed and sanded to shape.	______	______
3. Bent aluminum to fit curve of side pieces.	______	______
4. Clamped side pieces and set up 18" apart; tacked aluminum on with brads.	______	______
5. Notched both side pieces 1/4" × 1/4", centered, for skewer.	______	______
6. Notched left side piece 1" × 1", 3/4" up from skewer notch.	______	______
7. Made 1/8" black dot in center of bottom of 1" notch for target spot.	______	______
8. Cut aluminum tab and drilled sun hole and mounting holes.	______	______
9. Cut uprights for cooker.	______	______
10. Drilled holes in uprights and side pieces of cooker and attacked to uprights.	______	______
11. Set uprights/cooker on base and marked holes, drilled and assembled.	______	______
12. Tested cooker.	______	______
13. Checked in/put away tools and materials.	______	______
14. Cleaned the work area.	______	______
15. Used proper tools correctly.	______	______
16. Performed steps in a timely manner (___hrs. ___min. ___sec.)	______	______
17. Practiced safety rules throughout procedure.	______	______
18. Provided satisfactory responses to questions asked.	______	______

EVALUATOR'S COMMENTS: ____

____

PRACTICAL TEST

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

	4	3	2	1
Cooker assembly	Meets Specifications	Minor Adjustment	Major Adjustment	Rework
	4	3	2	1
Reflector unit	Very Effective	Effective	Modify	Redesign
	4	3	2	1
BTU	Wide temperature change	Moderate temperature change	Some temperature change	Little difference

EVALUATOR'S COMMENTS: ____________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled — Can perform job with no additional training.
3 — Moderately skilled — Has performed job during training program; limited additional training may be required.
2 — Limited skill — Has performed job during training program; additional training is required to develop skill.
1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

ENERGY/POWER CONVERSION AND MEASUREMENT
UNIT II-E

NAME ______________________________ SCORE ______________________

TEST

1. Match the terms on the right with the correct definitions.

   _____a. A type of fuel cell that provides steady current across the terminal to drive electrical motors

   _____b. The process of changing from one form to another

   _____c. An organized way of doing a job or task

   _____d. A device or strip of curved metal used to convey current from the armature to the brushes

   _____e. The property which enables certain metals and metallic oxides to attract other metals

   1. Armature
   2. Commutator
   3. Conversion
   4. Electromagnet
   5. Hydrox cell
   6. Photovoltaic
   7. System model
   8. Magnetism

2. Match the forms of energy on the right with the correct descriptions.

   _____a. The energy of motion, the most common and visible form of energy

   _____b. The visible part of radiant energy consists of electromagnetic waves traveling through space

   _____c. Energy produced by chemical changes; the source of energy for all living things

   _____d. The motion of tiny invisible particles of matter called electrons

   1. Chemical energy
   2. Electrical energy
   3. Heat energy
   4. Light energy
   5. Mechanical energy
   6. Nuclear energy

3. Complete the following statements concerning characteristics of energy by circling the correct words.

   a. Energy (**can, can not**) be created or destroyed.

   b. Energy (**can, can not**) be converted from one form to another form.

   c. We are usually trying to convert (**kinetic, potential**) energy such as chemical or nuclear fuels into (**kinetic, potential**) energy such as mechanical or electrical energy.

   d. An example of conversion would be (**exercise, an electric motor**) in which chemical energy converts to mechanical energy and thermal energy.

TEST

4. Distinguish between the types of conversions by placing a "D" for direct conversion and an "I" for indirect conversion next to the correct descriptions.

   _____a. When several conversions must take place before the energy is in the right form to do work

   _____b. When energy is used after only one conversion

5. Distinguish between the types of combustion engines by placing an "X" next to characteristics of the internal combustion engine.

   _____a. Gas, after being pressurized by heat, is piped to the engine.

   _____b. Is designed to vaporize and burn a mixture of air and fuel enclosed in a chamber called a cylinder

   _____c. Piston in cylinder may use two strokes or four strokes to complete a power cycle

   _____d. The heat energy is produced outside of the engine

6. Distinguish between energy and power by placing an "X" next to the definition of energy.

   _____a. Capacity to do work or the accomplishment of work

   _____b. Rate at which energy is used — work/time

7. Arrange in order the stages of the basic power theory by indicating the first stage as 1, the second stage as 2, and so on for each stage.

   _____a. Output

   _____b. Conversion and control

   _____c. Input

   _____d. Transmission and control

8. Complete the following statements concerning the measurement of energy and power by placing the correct number designations in the appropriate blanks.

   _____a. Any push or pull on an object is the definition of __________.

      1) Pressure
      2) Force
      3) Work

TEST

_____b. The standard U.S. unit of measurement for work is _____________.

1) Pound
2) Horsepower
3) Foot-pound

_____a. The standard U.S. unit of measurement for power is _____________.

1) Pound
2) Horsepower
3) Foot-pound

_____d. _____________ is the useful motion or motion that results in something useful being done.

1) Work
2) Force
3) Pressure

_____e. British thermal units — The heat needed to raise the temperature of one pound of water _____________ degree(s) Fahrenheit.

1) 10
2) 5
3) 1

_____f. _____________ $= \frac{\text{Force}}{\text{Area}}$

1) Torque
2) Force
3) Pressure

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

9. Identify types of energy used in converting one form of energy into another. (Assignment Sheet #1)

10. Solve problems calculating work, horsepower, and torque. (Assignment Sheet #2)

11. Demonstrate the ability to:

    a. Build a simple electric motor. (Job Sheet #1)

    b. Build a solar cooker. (Job Sheet #2)

ENERGY/POWER CONVERSION AND MEASUREMENT
UNIT II-E

ANSWERS TO TEST

1. a. 5
   b. 3
   c. 7
   d. 2
   e. 8

2. a. 5
   b. 4
   c. 1
   d. 2

3. a. Can not
   b. Can
   c. Potential, kinetic
   d. Exercise

4. a. I
   b. D

5. b, c

6. a

7. a. 4
   b. 2
   c. 1
   d. 3

8. a. 2
   b. 3
   c. 2
   d. 1
   e. 3
   f. 3

9.-10. Evaluated to the satisfaction of the instructor

11. Performance skills evaluated to the satisfaction of the instructor

POWER TRANSMISSION, CONTROL, AND STORAGE
UNIT III-E

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify simple machines and control devices, determine the mechanical advantage of a lever, and design and build a model racer. Competencies will be demonstrated by completing the assignment sheets, job sheets, and unit tests with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match the terms related to power transmission, control, and storage with the correct definitions.
2. Distinguish between the types of power systems.
3. Distinguish between the types of fluid power systems.
4. Match parts of fluid power systems with the correct descriptions.
5. List in order the stages of fluid power systems.
6. Complete statements concerning the stages of electrical power systems and their devices.
7. Identify types of simple machines.
8. Select from a list functions of machines.
9. Match terminology related to machines with the correct definitions.

OBJECTIVE SHEET

10. Identify types of motion.
11. Select from a list the laws of motion.
12. Match terminology related to motion with the correct definitions.
13. Identify devices for transmitting and controlling mechanical power.
14. Complete statements concerning storing potential and kinetic energy.
15. Solve problems calculating velocity and miles per hour. (Assignment Sheet #1)
16. Design a model racer using a system model. (Assignment Sheet #2)
17. Demonstrate the ability to:
    a. Determine the mechanical advantage of a lever. (Job Sheet #1)
    b. Build a model racer. (Job Sheet #2)

POWER TRANSMISSION, CONTROL, AND STORAGE
UNIT III-E

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Provide students with job sheets.

H. Discuss and demonstrate the procedures outlined in the job sheets.

I. Integrate the following activities throughout the teaching of this unit:

   1. Show videos and/or films on hydraulics, pneumatics, robotics, and other power transmission methods.
   2. Have students bring pictures of examples of how hydraulics and pneumatics are used in today's technology from newspapers and magazines for display.
   3. Arrange a field trip to view fluid devices on heavy construction equipment.
   4. Mechanical, hydraulic, pneumatic, and robotic trainers may be used in this unit.
   5. Use syringes, plastic tubing, and other materials to build a robot. Demonstrate the principles of hydraulic and pneumatic movement.
   6. Have students build model rockets from kits. Kits may be purchased at local hobby shops.
   7. Construct a wind tunnel to test the student-designed cars.

REFERENCES USED IN DEVELOPING THIS UNIT

8. You may wish to have students build their design race cars from scratch or from kits. Kits may be purchased from the following:

   Pitsco, Inc.
   Box 1328
   Pittsburg, KS 66762

9. AIASA, the American Industrial Art Student Association, sponsors Metric "500" races in many states and a national conference in which this is one of the 28 competitive events. Discuss with students whether or not they would like to compete.

10. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

J. Give test.

K. Evaluate test.

L. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Bame, E. Allen, and Paul Cummings. *Exploring Technology.* Worcester, MA: Davis Publications, Inc., 1980.

B. Bohn, Ralph C., et. al. *Energy, Power, and Transportation Technology.* Peoria, IL: Bennett & McKnight, 1986.

C. Groneman, Chris H. and John L. Feirer. *General Industrial Education and Technology.* 7th ed. New York: McGraw-Hill, 1986.

D. Hanks, Boyd. *Race Car.* Salt Lake City, UT: Quest Publishing Company, 1977.

SUGGESTED SUPPLEMENTAL RESOURCES

A. **Films**

1. *Mechanics of Fluids: Fundamental Principles of Flow* (23 min. color)
   University of Illinois
   Visual Aids Service
   1325 South Oak Street
   Champaign, IL 61820

2. *Fluid Flow in Hydraulic Systems* (10 min. color)
   University of Illinois
   Visual Aids Service
   1325 South Oak Street
   Champaign, IL 61820

INSTRUCTIONAL MATERIALS INCLUDED IN THIS UNIT

B. **Videos**

1. *For Years to Come*, Chrysler Corporation. (26 min.) Available in 16 mm, ¾" U-Matic, ½" Beta, or ½" VHS from the following:

   Marathon International Productions, Inc.
   211 East 51st Street
   New York, NY 10022

2. *Believing the Dream*, (20 min.), 1986. Documents the designing and testing of a dragster and the development of a vocational student organization competitive event around the dragster. Available from:

   Pitsco, Inc.
   Box 1328
   Pittsburg, KS 66762

POWER TRANSMISSION, CONTROL, AND STORAGE
UNIT III-E

INFORMATION SHEET

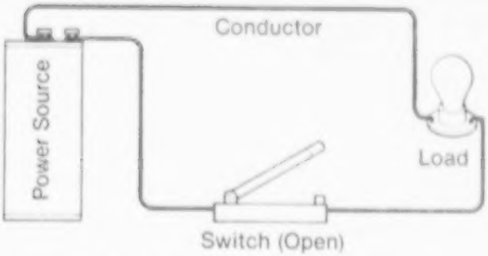
I. **Terms and definitions**

A. Battery — Two or more cells connected together

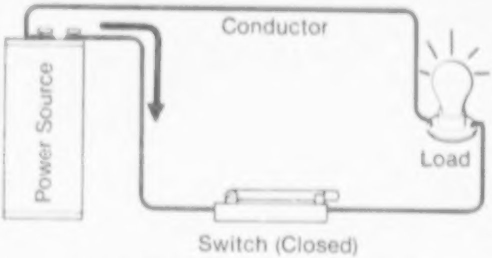
B. Cell — A container that holds electrodes and electrolytes for generating electricity by chemical action

C. Circuit — The complete path of an electric current

(NOTE: A circuit must have 4 parts — A source of power, a conductor, a switch, and a load. The following illustrations show these parts in an open circuit and in a closed circuit. An open circuit is usually broken by an open switch or a disconnected wire. A closed circuit is required for current flow.)



Simple Circuit (Open Circuit)



Simple Circuit (Closed Circuit)

D. Conductor — A substance capable of transmitting electricity easily

Examples: Silver, copper, aluminum

E. Electric current — The movement of electrons through a conductor

F. Engine — Device that converts any form of energy into mechanical energy

G. Fluid — Any liquid or gas

H. Inertia — The tendency of an object at rest to remain at rest, and of an object in motion to continue in motion

I. Insulator — A substance that does not allow the transmitting of electricity

Examples: Glass, dry wood, rubber

J. Machine — Device that changes the relationship between force and speed

K. Motor — An electrical- or fluid-operated device that produces rotary motion

L. Voltage — The electromotive force that causes electrons to move through a circuit

INFORMATION SHEET

II. **Types of power systems**

A. Fluid power — Involves the use of a liquid or a gas within an active system to transmit energy.

B. Electrical power — Involves the use of conductive material to transmit energy.

C. Mechanical power — Involves the use of gears, pulleys, belts, levers, shafts, and similar devices to transmit energy.

III. **Types of fluid power systems**

A. Hydraulic systems — Use liquid under pressure to produce motion and perform work.

Examples: Lifts, landing gears

B. Pneumatic systems — Use air or gas under pressure to produce motion and perform work.

Examples: Bellows, air compressors

IV. **Parts of fluid power systems** (Transparency 1)

A. Fluid — Gas, liquid, or both which serves as source of energy

B. Reservoir or receiver — Container that stores fluid

C. Pump or compressor — Supplies fluid under pressure and converts mechanical power to fluid power

(NOTE: Pumps are used in hydraulic systems, and compressors are used in pneumatic systems. Compressors force gas molecules together to keep the gases moving at the correct pressures. Liquids cannot be compressed the way gases can, so liquid systems use pumps.)

D. Filter — Device that cleans the fluid as it travels through the system

E. Transmission lines — A system of pipes and hoses that carry fluid

F. Control valves — Devices that regulate the fluid pressure, flow rate, and direction

(NOTE: There are many types of valves and each is designed for specific purposes such as starting-stopping, preventing backflow, or for safety purposes such as pressure relief valves.)

G. Actuator — A cylinder, motor, or other converter that changes fluid pressure into the desired mechanical form

INFORMATION SHEET

V. **Stages of fluid power systems**

   A. Source (input) — Fluid power is always a secondary form of power. The primary source is the engine or electric motor.

   B. Transmission and control — Fluid power is transmitted through pipes and hoses.

   C. Use (output) — Fluid power must be changed back to mechanical power.

VI. **Stages of electrical power systems and their devices** (Transparencies 2-4)

   A. Devices for generation of electrical power (input)

      1. Cells — Used to store energy and deliver it on demand

         a. Primary cell — Produces power by direct chemical conversion. Once the chemical is used up, it cannot be recharged and is thrown away.

         b. Secondary cell — Converts electricity into chemical energy, holds it until needed, and changes it back into electricity. Must be recharged by another power source after its chemical energy is used up.

         (NOTE: Secondary cells are often grouped together to form storage batteries.)

      2. Generators — Generate current that flows in only one direction (direct current — DC)

      3. Alternators — Generate current that changes direction many times a second (alternating current — AC)

   B. Devices for control of electrical power

      1. On-Off control devices (switches)

         a. Manual switch — Most common electrical control device

         Example: Common on-off light switch

         b. Relays — Allow the control of a circuit from a remote location

         c. Transistors — Control like relays except they have no moving parts; solid state

INFORMATION SHEET

2. Directional and overload control devices

    a. Diodes — Permit current to flow in only one direction; solid state

    b. Fuses — Protect a circuit from dangerous overloads; must be replaced after use

    c. Circuit breakers — Have the same job as a fuse, but can be reset by hand after circuit is broken

3. Current and voltage control devices

    a. Transformers — Allow current to be stepped up or down

    b. Resistors — Reduce current flow and control voltage drop

C. Devices for transmission of electrical power — Current-carrying wires consisting of a conductor surrounded by an insulating material

(NOTE: Electricity is transmitted more efficiently than any other form of power.)

D. Devices for output of electrical power

1. Solenoids — Change electricity into linear motion

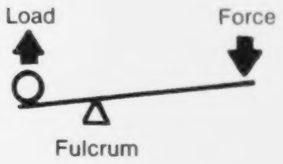
2. Motors — Change electricity into rotary motion

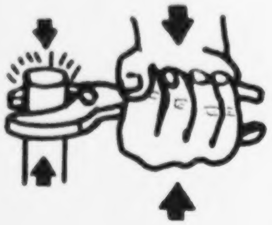
VII. Types of simple machines

A. Lever — A bar that rests on a pivot point (fulcrum) and some point along the bar.

1. First class lever

Examples: Teeter totter, wrench

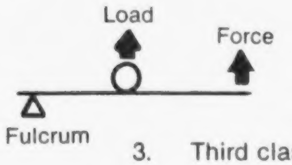


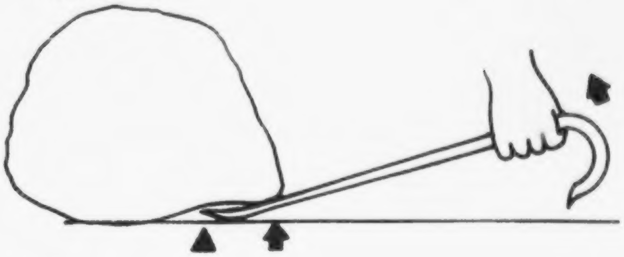


INFORMATION SHEET

2. Second class lever

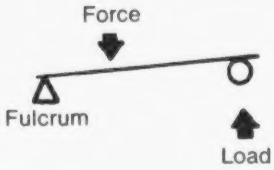
Example: Wheelbarrow

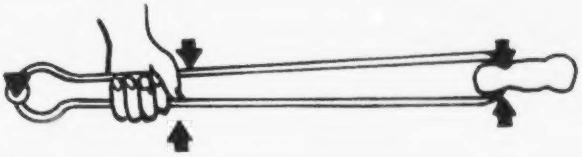

Load
Force
Fulcrum



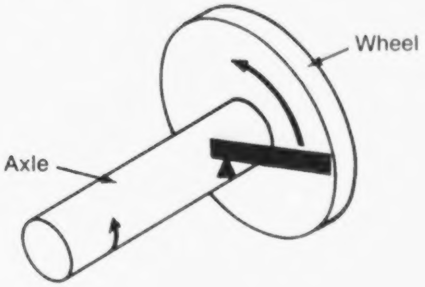
3. Third class lever

Example: Human arm


Force
Fulcrum
Load

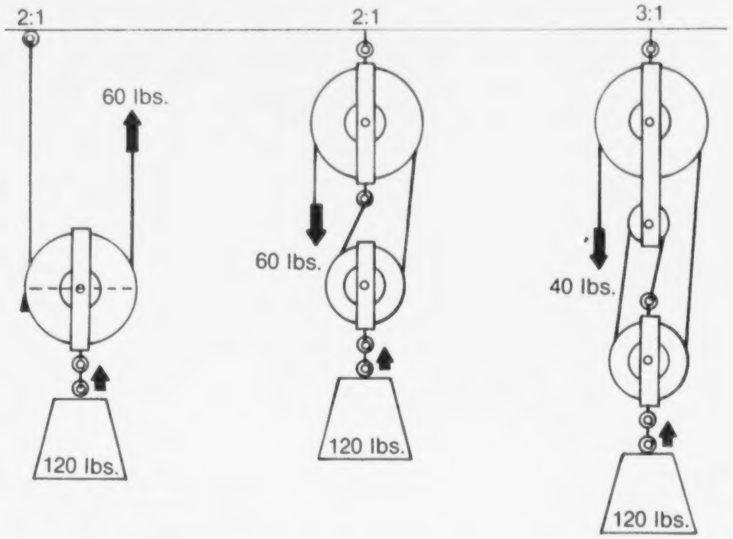


B. Wheel and axle — Works on the same principle as a lever, radius of wheel acts as the lever, center of the axle is the fulcrum

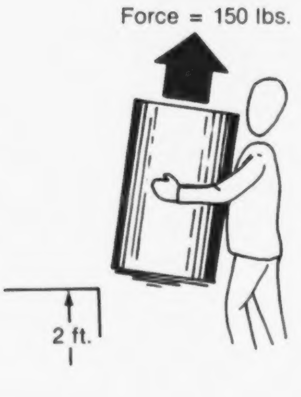


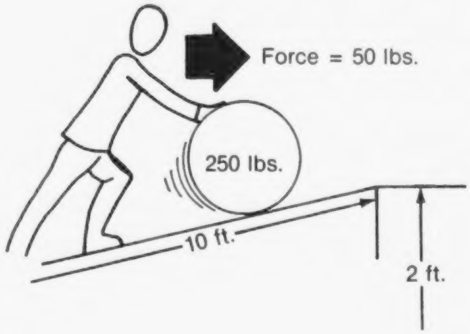
INFORMATION SHEET

C. Pulley — Lever in the pulley is either its radius or its diameter. The fulcrum is either the axle or the edge of the pulley.


2:1
60 lbs.
120 lbs.
2:1
60 lbs.
120 lbs.
3:1
40 lbs.
120 lbs.

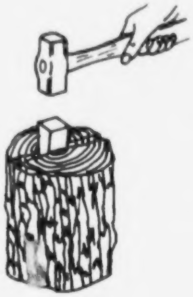
D. Inclined plane — A machine that makes use of a sloping surface


Force = 150 lbs.
2 ft.

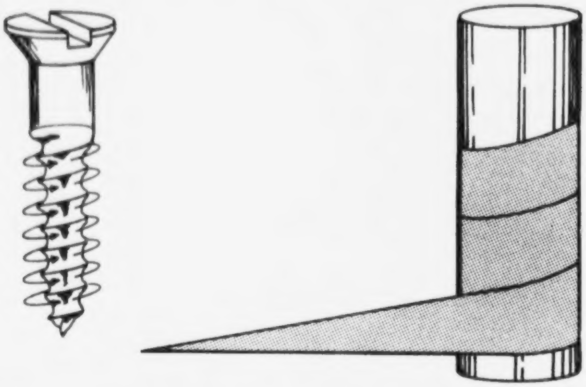

Force = 50 lbs.
250 lbs.
10 ft.
2 ft.

INFORMATION SHEET

E. Wedge — Two inclined planes placed so that the sloping sides come together at a point



F. Screw — An inclined plane cut in a spiral around a cone or shaft



(NOTE: All other machines are variations or combinations of these six simple machines.)

VIII. **Functions of machines — To modify mechanical power**

A. To increase force

B. To increase distance

C. To change direction

IX. **Terminology related to machines**

A. Efficiency — Ratio of the work output to the work input

$$E = \frac{\text{Work output}}{\text{Work input}} \times 100\%$$

INFORMATION SHEET

B. Effort — Force applied **to** the machine

C. Friction — Resistance to motion between two surfaces in contact; results in energy in the form of heat

(NOTE. Bearings and lubrication are used to reduce friction in mechanical devices.)

D. Fulcrum — The turning or pivot point of a lever

E. Mechanical advantage (MA) — The increase in force that you gain from using a machine

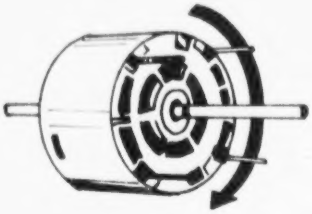
$$MA = \frac{\text{Resistance}}{\text{Effort}}$$

F. Resistance — Force overcome **by** the machine

X. Types of motion

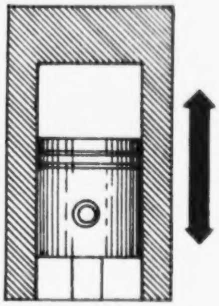
A. Rotary — Circular or turning motion

Examples: Fan, wheel, motor



B. Reciprocating — Up and down motion

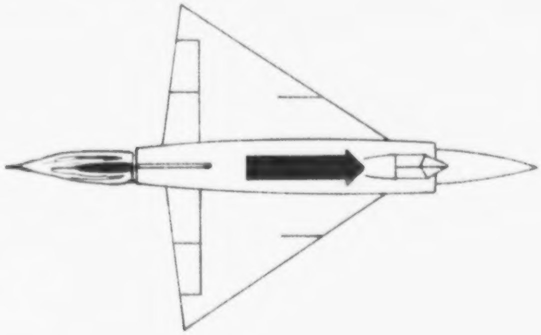
Example: Piston



INFORMATION SHEET

C. Linear — Motion in a straight line

Example: Jet engine



XI. Laws of motion (Newton's)

A. First Law of Motion — Every object continues in its state of rest (inertia) or of uniform straight-line motion unless acted upon by an unbalanced force.

B. Second Law of Motion — The net, unbalanced force acting on an object is directly proportional to, and in the same direction as, the acceleration of the object.

C. Third Law of Motion — To every action there is an opposite and equal reaction.

XII. Terminology related to motion

A. Acceleration — An increase in the speed of an object

B. Deceleration — A decrease in the speed of an object

C. Momentum — The measured force of a moving body. The faster a body moves, or the greater its weight, the greater its momentum.

D. Velocity — The speed of an object; distance per unit of time

XIII. Devices for transmitting and controlling mechanical power (Transparency 5)

A. Gears — Wheels that have teeth cut on their outside surfaces

B. Pulley — Metal or plastic wheel grooved around the outside

C. Belt — A flexible material used to drive pulleys

D. Sprocket and chain — Like gears except they are driven by chains instead of by other sprockets

E. Clutch — A device used to disconnect or connect a power train

F. Universal joint — A coupling that allows for alignment change

INFORMATION SHEET

XIV. Storing potential and kinetic energy

A. Storing potential energy — Chemical and nuclear energy

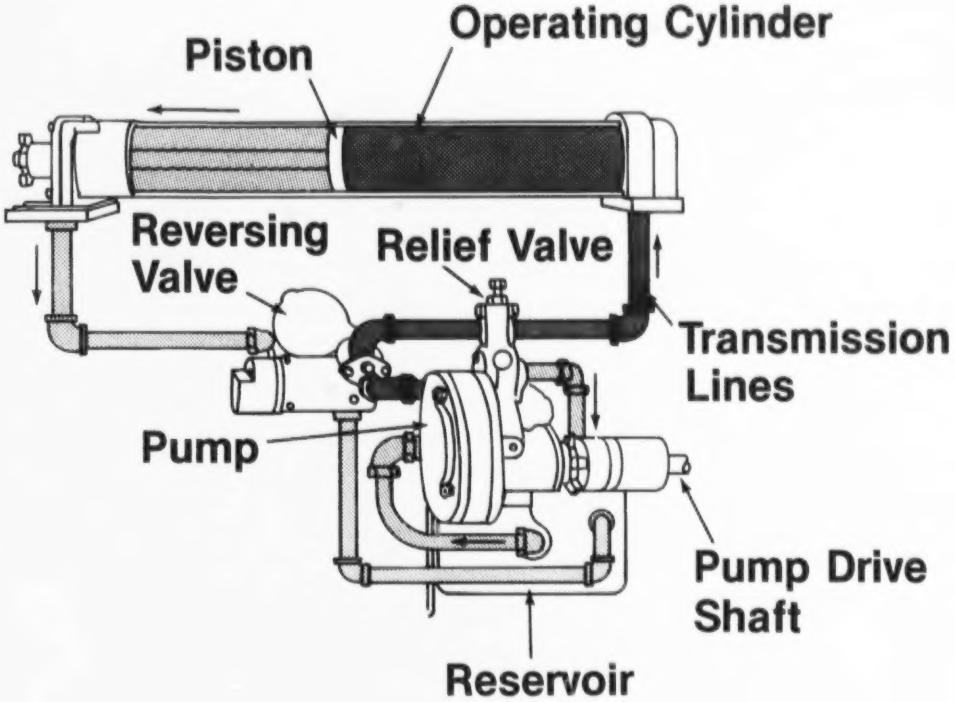
1. Can be stored for lengthy periods
2. Some may be liquified (natural gas) or pressurized (propane) to make them easier to be transported or stored.

B. Storing kinetic energy — Heat, mechanical, and electrical energy

1. May be stored momentarily or temporarily
2. Examples of momentary storage include electrical storage in capacitors and mechanical storage in a metal spring.
3. Examples of temporary storage include electrical storage in batteries, heat storage in a heat storage tank, and mechanical storage in a dam.

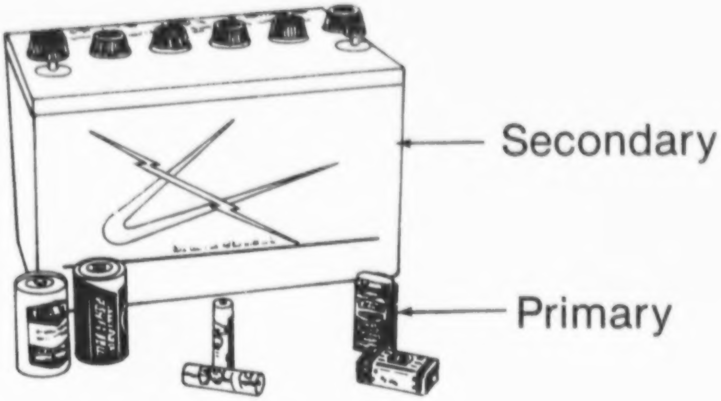
Parts of a Fluid Power System

(Hydraulic System Shown)

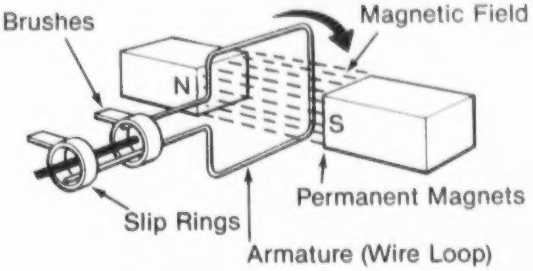

Operating Cylinder
Piston
Reversing Valve
Relief Valve
Transmission Lines
Pump
Pump Drive Shaft
Reservoir

Electrical Power Devices

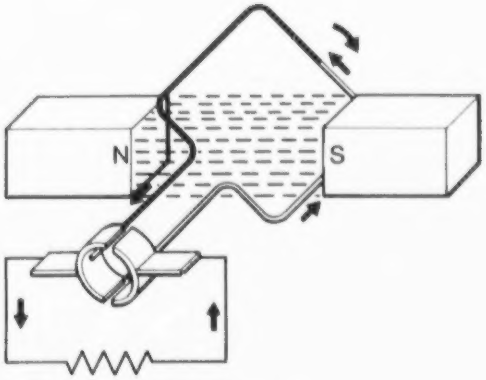
(Input)


Secondary
Primary

Battery Cells


Brushes
Magnetic Field
N
S
Slip Rings
Permanent Magnets
Armature (Wire Loop)

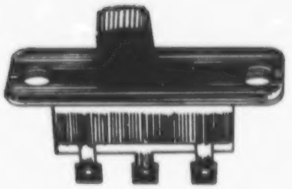
Alternator
(AC)



Generator
(DC)

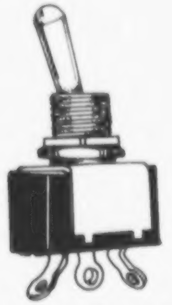
Electrical Power Devices

(Control)

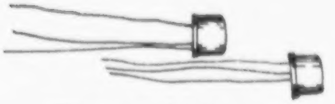


Slide Switch

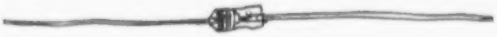
Switches



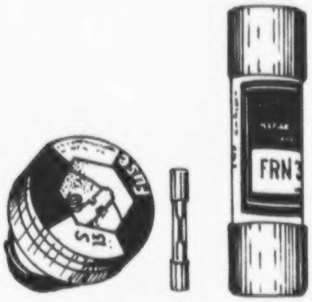
Toggle Switch



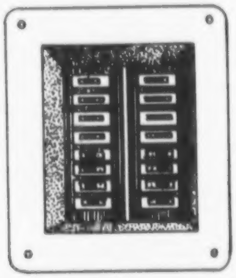
Transistors



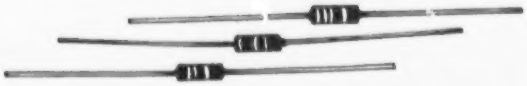
Diode



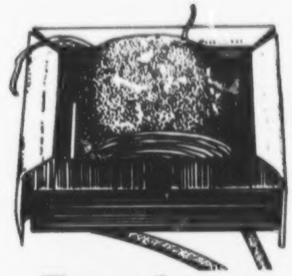
Fuses



Circuit Breaker



Resistors

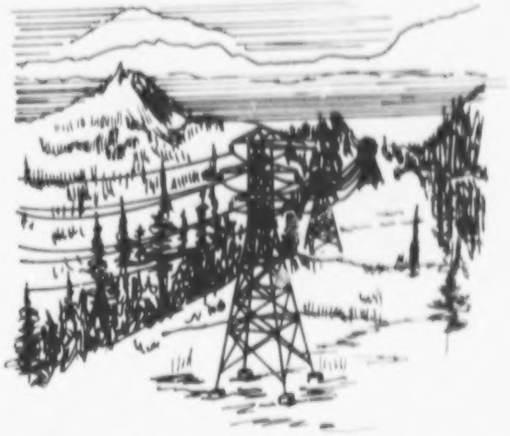


Transformer
(Iron Core)

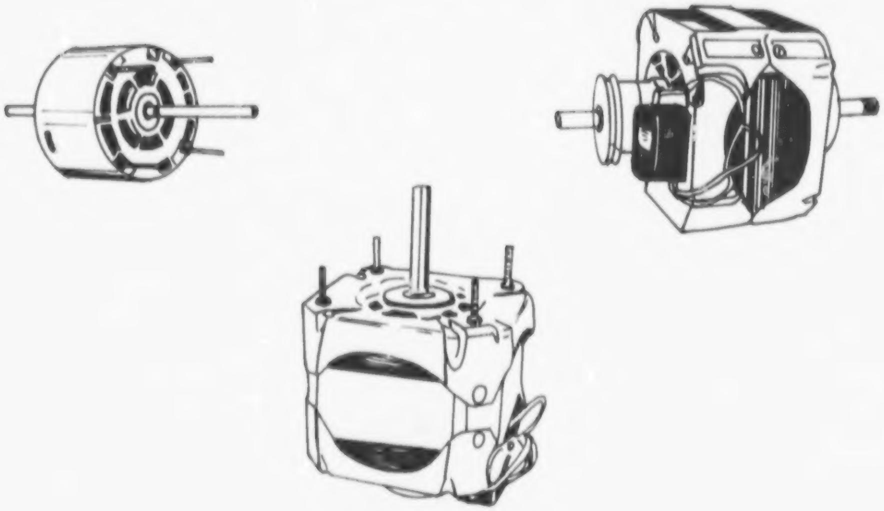
ETE-113-E

Electrical Power Devices

(Transmission and Output)

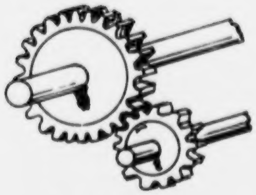


Transmission Lines

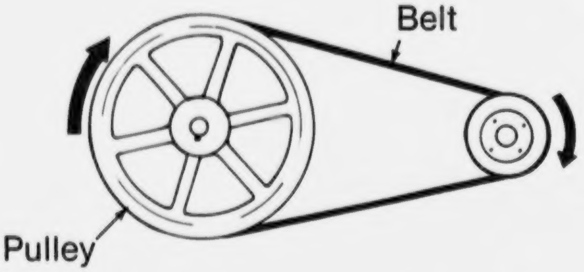


Motors

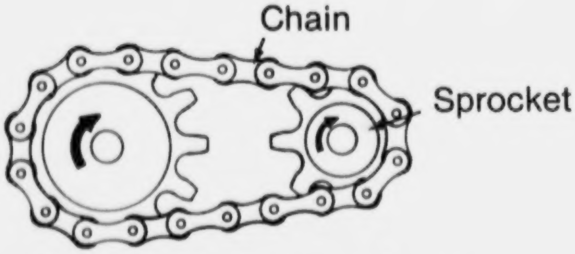
Mechanical Power Devices



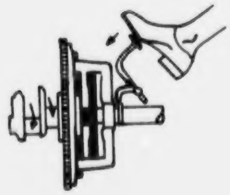
Gears


Belt
Pulley

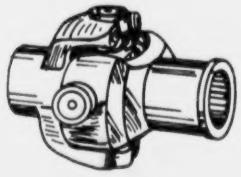
Pulleys and Belt


Chain
Sprocket

Chain and Sprockets



Clutch
(Friction)



Universal Joint

POWER TRANSMISSION, CONTROL, AND STORAGE
UNIT III-E

ASSIGNMENT SHEET #1 — SOLVE PROBLEMS CALCULATING VELOCITY AND MILES PER HOUR

NAME ______________________ SCORE ________

(NOTE: This activity will enable you to compute the miles per hour of the model racer that will be built later in this unit.)

A. Formulas

1. To calculate mph, the velocity of the object must be known. The formula for velocity measurement is:

$$\text{Velocity} = \frac{\text{distance in same direction}}{\text{time}} \quad \text{or} \quad V = \frac{d}{t}$$

2. Mph is the distance which an object would travel in one hour.

$$\text{Mph} = \frac{V \times 60 \text{ sec} \times 60 \text{ min}}{5280 \text{ ft}}$$

Using the velocity of the object, its speed in ft/s, m/s, ft/min, or mph can be calculated.

Example: If an object moved 60 ft in 1 second, how many mph was it going?

To find the answer:
(1) find the velocity.

$$v = \frac{\text{distance}}{\text{time}}$$

$$V = 60 \text{ ft} \div 1 \text{ sec} = 60 \text{ ft/sec.}$$

(2) Now use the formula to find mph.

$$\text{Mph} = \frac{V \times 60 \text{ sec} \times 60 \text{ min}}{5280 \text{ ft}}$$

$$\text{Mph} = \frac{60 \text{ ft/sec} \times 60 \text{ sec} \times 60 \text{ min}}{5280 \text{ ft}} = 40.9 \text{ mph}$$

(3) the answer is 40.9 mph.

ASSIGNMENT SHEET #1

B. Problems

(NOTE: A calculator may be used. Round off your answers to the nearest tenth.)

Given: "500" track length is 60 feet.

1. Compute the average velocity of a metric "500" car with a race time of .800 seconds.

   V = ______________

2. Compute the average mph of a metric "500" car with a race time of .800 seconds.

   mph = ______________

3. Compute the average velocity of a metric "500" car with a race time of .750 seconds.

   V = ______________

4. Compute the average mph of a metric "500" car with a race time of .750 seconds.

   mph = ______________

5. Compute the average velocity of a metric "500" car with a race time of .950 seconds.

   V = ______________

6. Compute the average mph of a metric "500" car with a race time of .950 seconds.

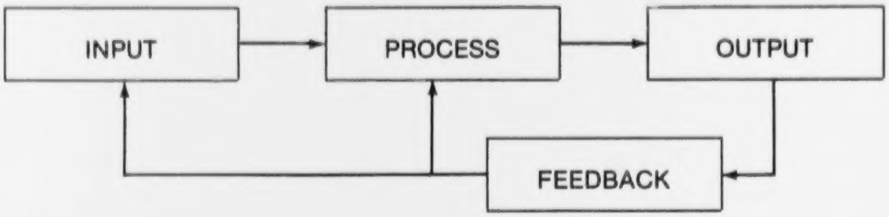
   mph = ______________

POWER TRANSMISSION, CONTROL, AND STORAGE
UNIT III-E

ASSIGNMENT SHEET #2 — DESIGN A MODEL RACER USING A SYSTEM MODEL

NAME ______________________________ SCORE ____________

Using the **INPUT** section of the system model, design a model racer using the specifications on the attached sheet for maximum and minimum dimensions.

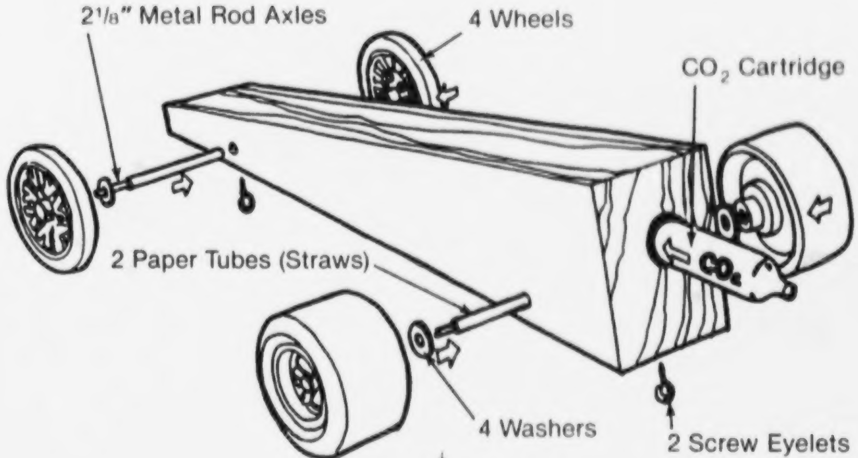


(NOTE: This would be the appropriate time to decide whether to obtain a kit form or do the complete production process.)

INPUT

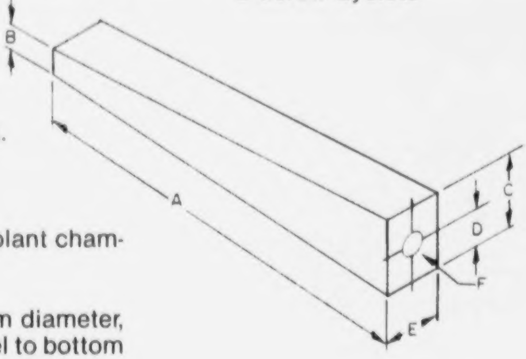
1. Design rough sketch
2. Draw final sketch
3. Check for correct specifications

ASSIGNMENT SHEET #2



Race Car Specifications

1. Maximum dimensions for Body Blank.
   - A. Length — 305 mm.
   - B. Front height — 20 mm.
   - C. Rear height — 70 mm.
   - D. Bottom to centerline of power plant chamber — 35 mm.
   - E. Width — 42 mm.
   - F. Power Plant Chamber — 20 mm diameter, 51 mm depth, and drilled parallel to bottom surface. A minimum of 3mm thickness around power plant housing must be maintained on all race cars for safety purposes. The position of the power plant must be as shown in the drawing.
   - G. The body of the model shall be one piece all-wood construction, and no parts (such as body strengtheners, fenders, plastic canopy, exhausts, or air foils) may be attached to or enclosed within the race cars. Bearings and lubricants may be used in construction.



2. Related dimensions[1].

	Maximum	Minimum
Axles (diam.)	3 mm	3 mm
Axles (length)	70 mm	42 mm
Axles Bearing (diam.)	4.5 mm	3.5 mm
Axle Hole (diam.)	4.5 mm	3.5 mm
Axle Hole (position above body bottom)	9 mm	7 mm
Axle Hole (position from either end of body)	10 mm	9 mm
Brass Spacer Bearing (diam.)	9 mm	8 mm

[1] Assembled without CO_2 cartridge

ASSIGNMENT SHEET #2

Body (length)	305	mm	200	mm
Body (height at rear with wheels)	75	mm	56	mm
Body (mass with wheels)	170.10	g	30	g
Body (width at axles)	42	mm	35	mm
Power Plant Housing (diam.)	20	mm	19	mm
Power Plant C/L[2] (from body bottom)	35	mm	31	mm
Screw Eye (eyelet inside diam.)	5	mm	3	mm
Screw Eyes (2) on C/L[2] of bottom, distance apart	270	mm	155	mm
Wheels, Front (diam.)	37	mm	32	mm
Wheels, Front (width at greatest diam.)	5	mm	2	mm
Wheels, Rear (diam.)	46	mm	36	mm
Wheels, Rear (width at greatest diam.)	18	mm	15	mm
Wheelbase	270	mm	105	mm

[2] Centerline

3. Wheels are to be made entirely from plastic.

POWER TRANSMISSION, CONTROL, AND STORAGE
UNIT III-E

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

1. V = 75
2. 51 mph
3. V = 80
4. 54.4 mph
5. V = 63.2
6. 43 mph

Assignment Sheet #2 — Evaluated to the satisfaction of the instructor

POWER TRANSMISSION, CONTROL, AND STORAGE
UNIT III-E

JOB SHEET #1 — DETERMINE THE MECHANICAL ADVANTAGE OF A LEVER

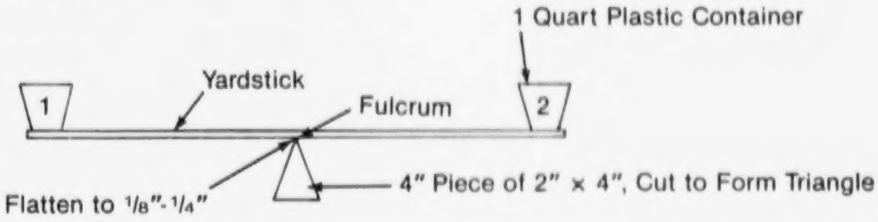
A. Tools and materials

1. 1 - yardstick
2. 1 - 4" scrap of 2" × 4" wood
3. 2 - One-quart plastic containers
4. Spring scale
5. Ruler or tape measure
6. Sand

B. Procedure

1. Cut the 4" scrap of 2" × 4" into a triangle.

FIGURE 1


1 Quart Plastic Container
Yardstick
Fulcrum
1
2
Flatten to 1/8"-1/4"
4" Piece of 2" × 4", Cut to Form Triangle

First-Class Lever

2. Flatten the top point of the triangle to make a flat surface 1/8" to 1/4" wide.

3. Place the yardstick on the top of the triangle so that the 18" mark is centered on the triangle.

   (NOTE: This is a first-class lever assembly. The top of the triangle is the fulcrum or balancing point.)

4. Place a one-quart container at each end. (Figure 1)

5. Fill one container half full of sand.

6. Fill the second container until the lever balances.

JOB SHEET #1

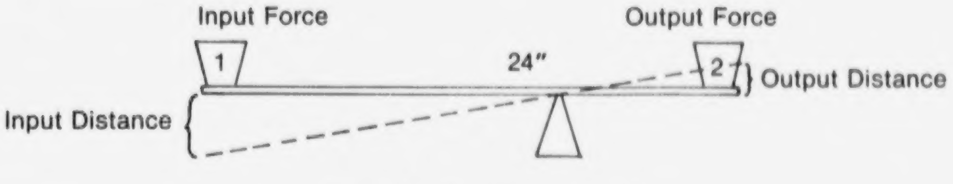
7. Use the spring scale to weigh each container.
   a. Weight of container 1: ____________ ounces
   b. Weight of container 2: ____________ ounces
8. Move container 1 from yardstick (level position) to the table.
9. Measure the distance moved by container 1 and container 2.
   a. Distance of container 1: ____________ inches
   b. Distance of container 2: ____________ inches
10. Calculate your input and output work.
    a. Input work = output work
    (container 1 = container 2)
    b. Distance × force = Distance × force
11. Using the information gained in steps 7 and 9, compute as follows:
    a. ______ inches × ______ ounces = ______ inches × ______ ounces

    (Input) (Output)

    b. ____________ inch-ounces = ____________ inch-ounces

    (NOTE: The two measurements should be the same.)
12. Remove container 2.
13. Position the fulcrum at the 24" mark of the yardstick. (Figure 2)

FIGURE 2



Setting to Provide MA = 2:1

14. Fill container 2 about $^2/_3$ full of sand.
15. Fill container 1 until they balance.

JOB SHEET #1

16. Repeat steps 7 and 9.

    a. Weight of container 1: ____________ ounces

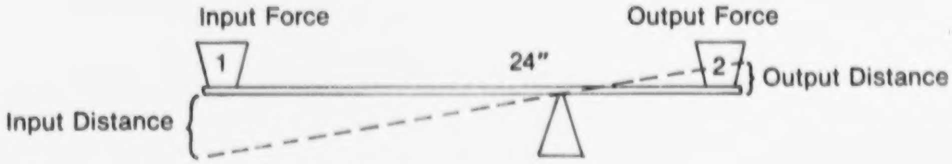
    b. Weight of container 2: ____________ ounces

    c. Distance of container 1: ____________ inches

    d. Distance of container 2: ____________ inches

17. Look at container 2. Notice that it had twice as much sand as container 1 when balanced. Just a little more sand in container 1 will lift container 2. This ratio of 1 to 2 or 1:2 is called mechanical advantage. One pound of force can lift two pounds. However, container 1 must move twice the distance of container 2. We gain in force, but lose in distance.

FIGURE 3



Setting to Provide MA = 2:1

18. Calculate input and output work as you did in step 11.

    a. ______ inches × ______ ounces = ______ inches × ______ ounces

    (Input) (Output)

    b. ____________ inch-ounces = ____________ inch-ounces

19. Explain any difference between input and output work.

POWER TRANSMISSION, CONTROL, AND STORAGE
UNIT III-E

JOB SHEET #2 — BUILD A MODEL RACER

A. Tools and materials

1. Wood block ($1^5/_8$" × $2^3/_4$" × 12") or (42 mm × 70 mm × 300 mm)
2. Templates and carbon paper
3. Pencil
4. Masking tape
5. Rubber bands
6. 1 - half round cabinet file
7. Coarse, medium, and fine sandpaper
8. Pliers
9. Scratch awl
10. $^3/_{16}$" twist drill
11. Half round wood rasp
12. C-clamps
13. Hand drill or drill press*
14. Scroll saw, coping saw, or bandsaw*

    (NOTE: *If power tools are used, have your teacher explain the proper and safe use before going any further. BE CAREFUL and FOLLOW SAFETY PRECAUTIONS!)
15. $^3/_4$" spade bit

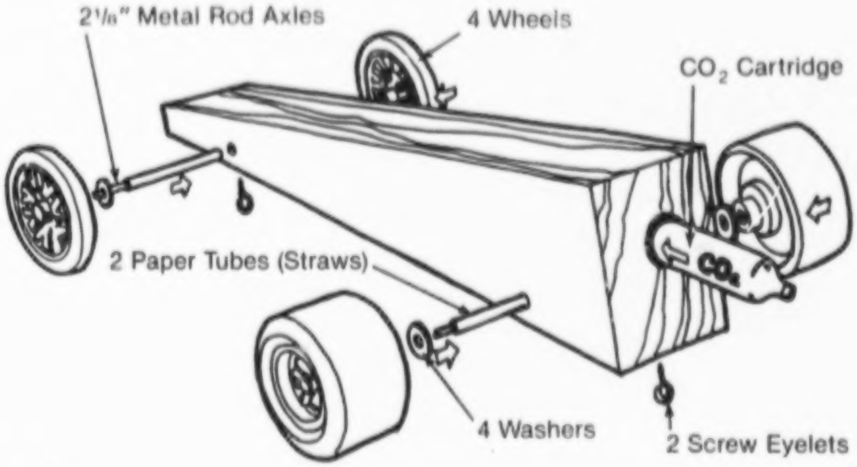
    (NOTE: Entire kit may be purchased from Pitsco, Inc., Box 1328, Pittsburg, KS 66762.)
16. Screw eyes (2)
17. Straw tubes
18. Washers (4)

JOB SHEET #2

19. Plastic wheels (2 front, 2 rear)

20. Axles (2 - 1/8" metal rod axles)

FIGURE 1



B. Procedure

1. Complete Assignment Sheet #2 on designing the racer using the systems model.

2. Make a rough sketch showing two views of your car.

3. Using a grid sheet, draw a full scale model of your car (top and side).

   (NOTE: Students should check drawings at this point for the following:

   ☐ Is the front axle in the correct position?

   ☐ Is rear axle in correct position?

   ☐ Is there sufficient room for CO_2 engine to fit in correct position?

   ☐ Does design fit within the height, width, and length dimensions allowed in Assignment Sheet #2?

4. Place drawing and carbon paper together and cut out drawing and carbon paper with scissors.

   (NOTE: These are templates or pattern pieces.)

5. Tape side-view template onto wooden block and trace around template with pencil; remove template.

6. Tape the top-view template to the bottom of the block and trace around template with pencil; remove template.

JOB SHEET #2

7. Mark axle locations.

8. Drill axle holes.

   (NOTE: Check limitations for correct position. Have instructor's approval before using any power equipment!)

9. Drill hole for CO_2 engine cartridge.

   (NOTE: Check limitations guides for exact placement.)

10. Cut the patterns using coping saw or bandsaw.

11. Shape the top view using wood rasp and a file.

12. Smooth body by sanding.

    (NOTE: First use rough (60 grit) sandpaper, then medium sandpaper (100 grit).)

13. Cut and install soda straw bearings.

14. Place washers in position.

15. Force wheels on axles.

16. Check wheels for secure attachment and to see that axles turn freely.

17. Determine exact location of screw eyes (see Figure 1).

18. Make holes using a scratch awl. Use pliers to insert and tighten screw eyes.

19. Look through screw eyes to check for interference.

20. Sand and smooth body (starting with 150 grit and finishing with 220 grit, after removing wheels, axles, and screw eyes.)

21. When car feels smooth, paint with a fast drying spray paint, at least two coats.

    (NOTE: Car should be placed on a dowel rod, inserted in engine hole to allow free access.)

22. Check paint for flaws, and make repairs if needed.

23. Place decals and numerals in proper place.

24. Reinsert wheels, axles, and screw eyes.

    (NOTE: Check wheels for flaws. Use fine sandpaper to smooth any bumps or irregularities. Graphite may be rubbed along axle to allow faster turning.)

25. Test car.

POWER TRANSMISSION, CONTROL, AND STORAGE
UNIT III-E

PRACTICAL TEST
JOB SHEET #1 — DETERMINE THE MECHANICAL ADVANTAGE OF A LEVER

STUDENT'S NAME ______________________ DATE __________

EVALUATOR'S NAME ______________________ ATTEMPT NO. ______

Instructions: When you are ready to perform this task, ask you instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:	YES	NO
1. Checked out proper tools and materials.	______	______
2. Cut wood into triangle and flatten top point.	______	______
3. Centered yardstick on triangle.	______	______
4. Placed and filled containers at each end.	______	______
5. Weighed containers.	______	______
6. Measured distance moved.	______	______
7. Calculated input and output work for first class lever.	______	______
8. Repositioned fulcrum and repeated steps 4-7.	______	______
9. Explained any difference between input and output work.	______	______
10. Checked in/put away tools and materials.	______	______
11. Cleaned the work area.	______	______
12. Used proper tools correctly.	______	______
13. Performed steps in a timely manner (___hrs. ___min. ___sec.)	______	______
14. Practiced safety rules throughout procedure.	______	______
15. Provided satisfactory responses to questions asked.	______	______

EVALUATOR'S COMMENTS: ____

____

PRACTICAL TEST #1

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

	4	3	2	1
Fulcrum	Performed Well	Performed Satisfactorily	Performed Poorly	Redo
	4	3	2	1
Experiment #1	Performed Well	Performed Satisfactorily	Performed Poorly	Redo
	4	3	2	1
Experiment #2	Performed Well	Performed Satisfactorily	Performed Poorly	Redo
	4	3	2	1
Explanation	Understood Principle	Satisfactory Understanding	Poor Understanding	No Understanding

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled — Can perform job with no additional training.
3 — Moderately skilled — Has performed job during training program; limited additional training may be required.
2 — Limited skill — Has performed job during training program; additional training is required to develop skill.
1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

POWER TRANSMISSION, CONTROL, AND STORAGE
UNIT III-E

PRACTICAL TEST
JOB SHEET #2 — BUILD A MODEL RACER

STUDENT'S NAME ______________________ DATE ____________

EVALUATOR'S NAME ______________________ ATTEMPT NO. ______

Instructions: When you are ready to perform this task, ask you instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

(EVALUATOR NOTE: Place a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.)

The student:	YES	NO
1. Checked out proper tools and materials.	______	______
2. Completed assignment sheet on system model.	______	______
3. Made rough sketches of car (two views).	______	______
4. Made drawings of car on grid sheet, full scale top and side.	______	______
5. Placed drawing and carbon together and cut out with scissors.	______	______
6. Taped and traced top and side view template onto car.	______	______
7. Marked and drilled holes for axles and CO_2 engine.	______	______
8. Cut out car with coping or bandsaw.	______	______
9. Shaped body with rasp and file and smooth by sanding.	______	______
10. Installed soda straw bearings, washers, axles, and wheels.	______	______
11. Checked wheels for secure attachment and freewheeling.	______	______
12. Centered and installed screw eyes and check for interference.	______	______
13. Sand smooth the body, paint, and check for touchup.	______	______
14. Placed decals and numerals/reinserted wheels.	______	______
15. Tested car.	______	______
16. Checked in/put away tools and materials.	______	______
17. Cleaned the work area.	______	______
18. Used proper tools correctly.	______	______
19. Performed steps in a timely manner (___hrs. ___min. ___sec.)	______	______
20. Practiced safety rules throughout procedure.	______	______
21. Provided satisfactory responses to questions asked.	______	______

EVALUATOR'S COMMENTS: ____

____

PRACTICAL TEST #2

PRODUCT EVALUATION

(EVALUATOR NOTE: Rate the student on the following criteria by circling the appropriate numbers. Each item must be rated at least a "3" for mastery to be demonstrated. (See performance evaluation key below.) If the student is unable to demonstrate mastery, student materials should be reviewed and another product must be submitted for evaluation.)

Criteria:

	4	3	2	1
Plan	Well Planned	Useful	Needs Revision	Unworkable
	4	3	2	1
Design	Meets Specifications	Minor Corrections	Major Corrections	Redesign
	4	3	2	1
Production	Well Done	Minor Flaws	Major Flaws	Required Additional Blank
	4	3	2	1
Finishing	Well Done	Minor Flaws	Major Flaws	Refinish
	4	3	2	1
Testing	Meets Specifications	Minor Modifications	Major Modifications	Major Overhaul

EVALUATOR'S COMMENTS: ______________________________

____

PERFORMANCE EVALUATION KEY

4 — Skilled — Can perform job with no additional training.
3 — Moderately skilled — Has performed job during training program; limited additional training may be required.
2 — Limited skill — Has performed job during training program; additional training is required to develop skill.
1 — Unskilled — Is familiar with process, but is unable to perform job.

(EVALUATOR NOTE: If an average score is needed to coincide with a competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria.)

POWER TRANSMISSION, CONTROL, AND STORAGE
UNIT III-E

NAME ______________________ SCORE ______________________

TEST

1. Match the terms on the right with the correct definitions.

_____a. Device that changes the relationship between force and speed

_____b. The tendency of an object at rest to remain at rest, and of an object in motion to continue in motion

_____c. Any liquid or gas

_____d. Two or more cells connected together

_____e. The movement of electrons through a conductor

_____f. An electrical- or fluid-operated device that produces rotary motion

_____g. The complete path of an electric current

_____h. A substance that does not allow the transmitting of electricity

1. Battery
2. Cell
3. Circuit
4. Conductor
5. Electric current
6. Engine
7. Fluid
8. Inertia
9. Insulator
10. Machine
11. Motor
12. Voltage

2. Distinguish between the types of power systems by placing the following letters next to the correct descriptions: "E" for electrical power, "F" for fluid power, and "M" for mechanical power.

_____a. Involves the use of gears, pulleys, belts, levers, shafts, and similar devices to transmit energy

_____a. Involves the use of conductive material to transmit energy

_____a. Involves the use of a liquid or gas within an active system to transmit energy

3. Distinguish between types of fluid power systems by placing an "X" next to the description of pneumatic systems.

_____a. Use air or gas under pressure to produce motion and perform work

_____b. Use liquid under pressure to produce motion and perform work

TEST

4. Match the parts of fluid power systems on the right with the correct descriptions.

______a. Device that cleans the fluid as it travels through the system

______b. A system of pipes and hoses that carry fluid

______c. Supplies fluid under pressure and converts mechanical power to fluid power

______d. Devices that regulate the fluid pressure, flow rate, and direction

______e. Gas, liquid, or both which serves as source of energy

1. Actuator
2. Control valves
3. Filter
4. Fluid
5. Pump or compressor
6. Reservoir or receiver
7. Transmission lines

5. List in order the stages of fluid power systems.

a. ______________________________

b. ______________________________

c. ______________________________

6. Complete the following statements concerning the stages of electrical power systems and their devices by circling the correct words.

a. A (**primary cell, secondary cell**) converts electricity into chemical energy, holds it until needed, and changes it back into electricity. Must be recharged by another power source after its chemical energy is used up.

b. Alternators generate (**direct, alternating**) current.

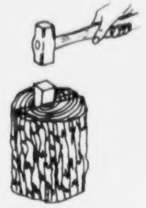
c. (**Transformers, Resistors**) allow current to be stepped up or down.

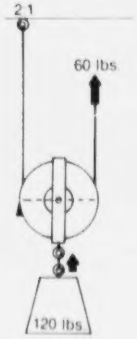
d. Solenoids change electricity into (**rotary, linear**) motion.

e. The most common electrical control device is the (**switch, diode**).

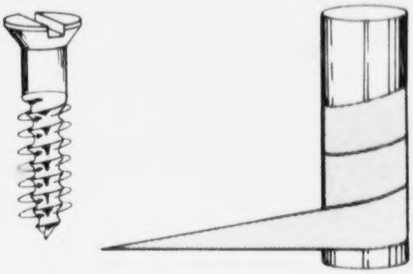
TEST

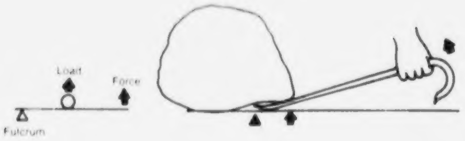
7. Identify the following types of simple machines.



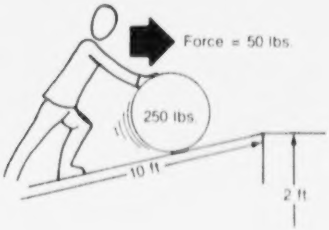

2:1
60 lbs.
120 lbs.

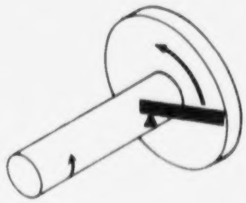
a. ______________________________ b. ______________________________




Load
Force
Fulcrum

c. ______________________________ d. ______________________________


Force = 50 lbs.
250 lbs.
10 ft
2 ft



e. ______________________________ f. ______________________________

8. Select from the following list the current functions of machines by placing an "X" in the appropriate blanks.

______a. To increase work

______b. To increase force

______c. To increase distance

______d. To change direction

______e. To decrease force

TEST

9. Match terms related to machines on the right with the correct definitions.

_____a. The increase in force that you gain from using a machine

_____b. Resistance to motion between two surfaces in contact; results in energy in the form of heat

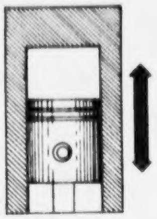
_____c. Ratio of the work output to the work input

_____d. Force applied to the machine

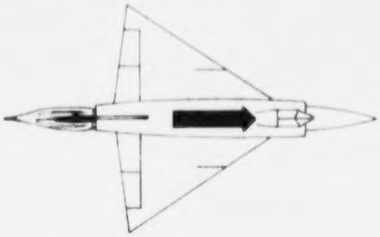
_____e. Force overcome by the machine

1. Efficiency
2. Effort
3. Friction
4. Fulcrum
5. Mechanical advantage
6. Resistance

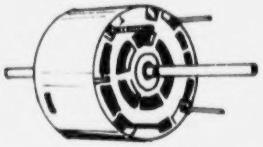
10. Identify the following types of motion.



a. ____________________



b. ____________________



c. ____________________

11. Select from the following list the laws of motion by placing an "X" in the appropriate blanks.

_____a. The volume of a gas varies directly with the temperature applied to it, provided the pressure remains constant.

_____b. To every action there is an opposite and equal reaction

_____c. Every object continues in its state of rest or of uniform straight-line motion unless acted upon by a balanced force.

_____d. The net, unbalanced force acting on an object is directly proportional to, and in the same direction as, the acceleration of the object.

12. Match the terms related to motion on the right with the correct definitions.

_____a. A decrease in the speed of an object

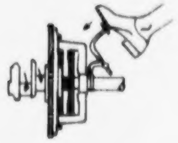
_____b. The speed of an object; distance per unit of time

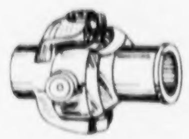
_____c. The measured force of a moving body

1. Acceleration
2. Deceleration
3. Momentum
4. Velocity

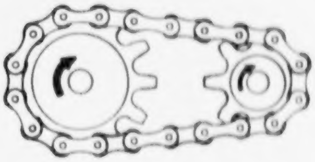
TEST

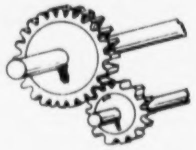
13. Identify the following devices for transmitting and controlling mechanical power.



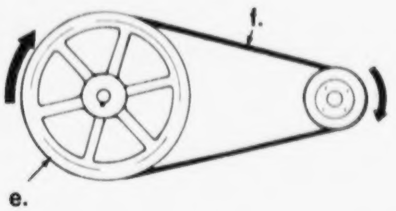


a. ______________________ b. ______________________





c. ______________________ d. ______________________



e. ______________________ f. ______________________

14. Complete the following statements concerning storing potential and kinetic energy by circling the correct words.

    a. (**Potential, Kinetic**) energy can be stored for lengthy periods.

    b. Heat, mechanical, and electrical energy are forms of (**kinetic, potential**) energy.

    c. An example of momentary storage includes (**mechanical, electrical**) storage in capacitors.

TEST

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

15. Solve problems calculating velocity and miles per hour. (Assignment Sheet #1)

16. Design a model racer using a system model. (Assignment Sheet #2)

17. Demonstrate the ability to:

    a. Determine the mechanical advantage of a lever. (Job Sheet #1)

    b. Build a model racer. (Job Sheet #2)

POWER TRANSMISSION, CONTROL, AND STORAGE
UNIT III-E

ANSWERS TO TEST

1. a. 10
b. 8
c. 7
d. 1
e. 5
f. 11
g. 3
h. 9

2. a. M
b. E
c. F

3. a

4. a. 3
b. 7
c. 5
d. 2
e. 4

5. a. Source (input)
b. Transmission and control
c. Use (output)

6. a. Secondary cell
b. Alternating
c. Transformers
d. Linear
e. Switch

7. a. Wedge
b. Pulley
c. Screw
d. Lever
e. Inclined plane
f. Wheel and axle

8. b, c, d

9. a. 5
b. 3
c. 1
d. 2
e. 6

ANSWERS TO TEST

10. a. Reciprocating
    b. Linear
    c. Rotary

11. b, c, d

12. a. 2
    b. 4
    c. 3

13. a. Clutch
    b. Universal joint
    c. Sprocket and chain
    d. Gears
    e. Pulley
    f. Belt

14. a. Potential
    b. Kinetic
    c. Electrical

15. Evaluated to the satisfaction of the instructor

16. Performance skills evaluated to the satisfaction of the instructor

TRANSPORTATION SYSTEMS
UNIT IV-E

UNIT OBJECTIVE

After completion of this unit, the student should be able to complete statements concerning the basic modes of transportation. Competencies will be demonstrated by completing the assignment sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms related to transportation systems with the correct definitions.
2. Classify parts of a transportation system according to a system model.
3. Select from a list the purposes of transportation.
4. Identify the environmental modes of transportation.
5. List transportation "ways."
6. Complete statements concerning highway transportation.
7. Select true statements concerning the highway network.
8. Complete statements concerning railway transportation.
9. Select true statements concerning air transportation.
10. Complete statements concerning airways and airports.
11. Complete statements concerning water transportation.

OBJECTIVE SHEET

12. Distinguish between types of waterways.

13. Complete statements concerning stationary transportation.

14. Calculate gas mileage problems. (Assignment Sheet #1)

15. Classify goods, services, and raw materials received and transported from your community. (Assignment Sheet #2)

TRANSPORTATION SYSTEMS
UNIT IV-E

SUGGESTED ACTIVITIES

A. Obtain additional materials and/or invite resource people to class to supplement/reinforce information provided in this unit of instruction.

(NOTE: This activity should be completed prior to the teaching of this unit.)

B. Make transparencies from the transparency masters included with this unit.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

(NOTE: Use the transparencies to enhance the information as needed.)

G. Integrate the following activities throughout the teaching of this unit:

1. Show films on transportation. Possible films are listed on the next page.
2. Have students create a model of a mini-conveyor system.
3. Contact gas company for pipeline distribution system information.
4. Discuss the advantages and disadvantages of each mode of transportation. Discuss how you would select one mode over the others. Consider economics, speed, and environmental factors.
5. Have students select their favorite mode of public transportation and list all the possible in-route services they can imagine.
6. Have students build rockets or gliders to demonstrate air transportation.
7. Meet individually with students to evaluate their progress through this unit of instruction, and indicate to them possible areas for improvement.

H. Give test.

I. Evaluate test.

J. Reteach if necessary.

REFERENCES USED IN DEVELOPING THIS UNIT

A. Bohn, Ralph C., et. al. *Energy, Power, and Transportation Technology.* Peoria, IL: Bennett & McKnight, 1986.

B. Lindbeck, John R. and Irvin T. Lathrop. *General Industry and Technology.* Encino, CA: Glencoe Publishing Company, 1986.

C. Smith, Howard Bud, ed. *Exploring Energy: Sources/Applications/Alternatives.* South Holland, IL: Goodheart-Willcox Co., Inc., 1985.

D. Walker, John R. *Exploring Power Technology: Basic Fundamentls.* South Holland, IL: Goodheart-Willcox Co., Inc., 1981.

SUGGESTED SUPPLEMENTAL RESOURCES

A. **Films**

1. *Working in Transportation,* 1982; #11151 (21 min.)
Bureau of Audio Visual Instruction
P.O. Box 2093
Madison, WI 53701-2093

2. *The Transportation Revolution: Story of America's Growth;* #03547 (19 min., color)
OSU AudioVisual Center
Stillwater, Oklahoma 74074
(405)624-7216

3. *American Transportation: Horseback to Jet* (#266)
Life Filmstrips
Time-Life Building
Rockefeller Center
New York, NY 10020

B. **Pamphlets and Charts**

1. *List of FAA Aviation Education Material*
Department of Transportation
Federal Aviation Administration
Washington, DC 20591

2. *Who in the World Needs Railroads?*
Public Relations Department
Atchison, Topeka, and Santa Fe Railway
80 East Jackson Boulevard
Chicago, IL 60604

3. *Plane Folder* (pictures of planes)
Delta Airlines, Inc.
Public Relations Department
Hartsfield-Atlanta International Airport
Atlanta, GA 30320

SUGGESTED SUPPLEMENTAL RESOURCES

4. *Big Load Afloat*
The American Waterways Operators, Inc.
1600 Wilson Boulevard
Suite 1101
Arlington, VA 22209

5. *America Runs on Wheels*
Motor Vehicle Manufacturer's Association of the U.S., Inc.
300 New Center Building
Detroit, Michigan 48202

6. *Energy and Transportation*
U.S. Department of Energy
Technical Information Center
P.O. Box 62
Oak Ridge, TN 37830

C. **Computer Software**

Glidepath, #566-00-MSA
Donald Morrison, HRM Software
175 Tompkins Avenue
Pleasantville, NY 10507

(for Apple II family)

TRANSPORTATION SYSTEMS
UNIT IV-E

INFORMATION SHEET

I. **Terms and definitions**

A. Break bulk cargo — Any kind of freight consisting of separate units

Example: TV sets, light bulbs

B. Bulk cargo — Any kind of loose cargo

Examples: Coal, gasoline, grain

C. Cargo/freight — Solid, liquid, or gaseous material being moved from one place to another

D. Containerization — The use of containers in intermodal transportation

E. Intermodal transportation — Using more than one mode to transport passengers or cargo

Examples: Using a taxi to get to the airport so you can fly to another state, using trucks to haul cargo to a ship that will then haul the cargo to another country

F. Mode — A particular form or way of doing something

G. Passengers — People who are being transported from place to place

H. Terminals — The beginning and ending points for loading and unloading passengers and cargo

I. Transportation — The movement of people and material

J. Vehicles — Transportation devices

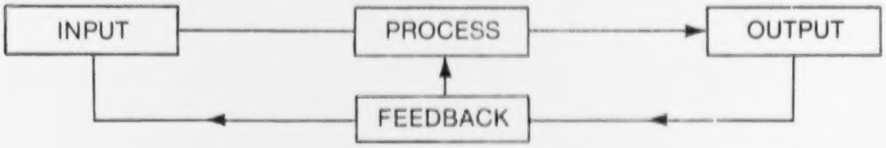
Examples: Motorcycles, buses, cars, trucks, airplanes, railroad cars, ships

INFORMATION SHEET

II. Parts of a transportation system

(NOTE: A system involves a combination of parts that work together to accomplish a desired goal. In this case, the goal is the movement of people or materials.)

FIGURE 1 — System model



A. Input

1. Capital

Examples: Working capital — Money for paying employees and buying supplies and equipment

Fixed capital — Equipment owned by company, warehouse, building

2. People

Examples: Employees to drive trucks, load and unload cargo, repair engines

3. Energy

Examples: Gasoline, diesel fuel, electricity

B. Processes

1. Management practices — Planning, organizing, controlling, directing

2. Production processes — Preparing to move, moving, completing the move

C. Output — Relocation of people and materials

D. Feedback — Monitoring the process and correcting problems

III. Purposes of transportation (Transparency 1)

A. For personal benefit

Examples: Driving the family car to and from the supermarket, sailing for pleasure, bicycling for exercise

INFORMATION SHEET

B. For commercial (monetary) gain

Examples: Trucking companies, taxis, cargo ships, United Parcel Service, air express companies, airlines

C. For government service or defense

Examples: City mass-transit buses, city garbage trucks, U.S. Postal Service, U.S. Naval Ships, U.S. Air Force cargo planes

IV. **Environmental modes of transportation** (Transparencies 2-4)

A. Land transportation (Transparency 2)

1. The earliest form of transportation was human.
2. Later beasts of burden (oxen, cows, horses) were used.
3. It was then discovered that these animals could pull sleds.
4. The addition of wheels to these sleds was a great advancement in transportation technology.

   (NOTE: The wheel is considered by many to be the greatest technological development of all time.)
5. From this simple beginning have come our modern automobiles, trucks, and trains.
6. The development of ironworking made it possible to make stronger wheels.
7. As iron wheels damaged the roads, better road surfaces were required.

B. Water transportation (Transparency 3)

1. The earliest form of water transportation consisted of logs or fallen trees along lakes, rivers, and shores.
2. It was discovered that logs could be fastened together to make rafts, which could carry heavier loads.
3. Later logs were hollowed out to form canoes.
4. The next big step was the use of oars to propel ships.

INFORMATION SHEET

5. Sails were then added to propel the ship when it was going in the same direction the wind was blowing.

   (NOTE: As a result of people using the navigable rivers and waterways, people began to settle along these areas and these villages became trade centers and grew into cities.)

6. Ocean-going and intercoastal shipping provided communication and trade among the cities and towns along the coast.

C. Air transportation (Transparency 4)

1. The first trips by humans in aircraft were in balloons in 1783.
2. Soon some experimenters were flying heavier-than-air gliders.
3. The Wright brothers launched and flew a powered heavier-than-air craft.
4. Lindberg's solo flight across the Atlantic marked the beginning of a new era in air transportation.
5. The space age is said to have begun October 4, 1957 when the Soviet Union launched Sputnik I.
6. In 1961 Russian cosmonaut Yuri Gagarin became the first human to orbit the earth.

V. Transportation "ways"

A. Highways

B. Railways

C. Waterways

D. Airways

VI. Highway transportation

A. Is a system of moving people and materials through a network of roads and highways.

B. Vehicles used on roads and highways include bicycles, motorcycles, cars, buses, and trucks.

C. Vehicles are *independently* controlled on the highway by the driver.

D. Highways are used for personal, commercial, and government transportation.

INFORMATION SHEET

E. Commercial passenger service includes taxi and limousine service, local and regional bus lines, and large inter-city bus lines.

F. Commercial freight service includes trucks and large tractor-trailers such as tankers, refrigerated vans, and flatbed trailers.

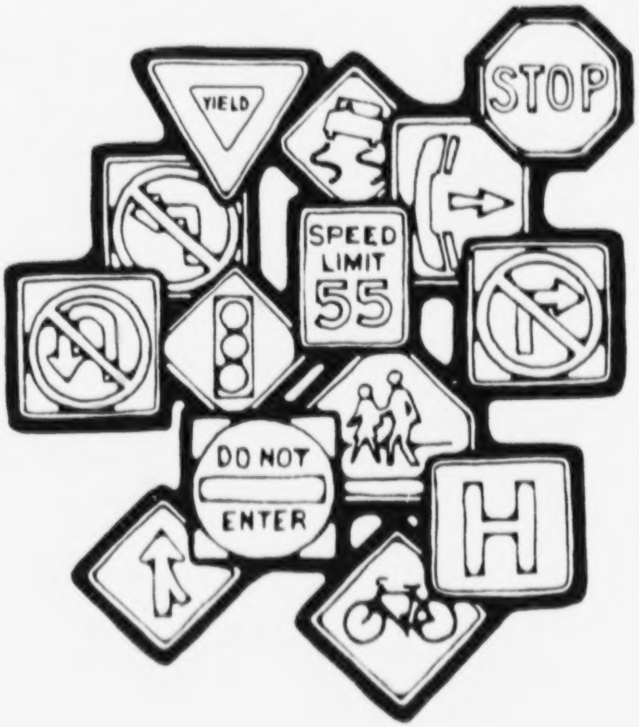
VII. Highway network

A. Consists of

1. Local roads and streets through towns and cities
2. County and state roads and highways
3. Interstate highways

B. Uses road signs and symbols to direct traffic and to communicate information to drivers, passengers, and pedestrians.

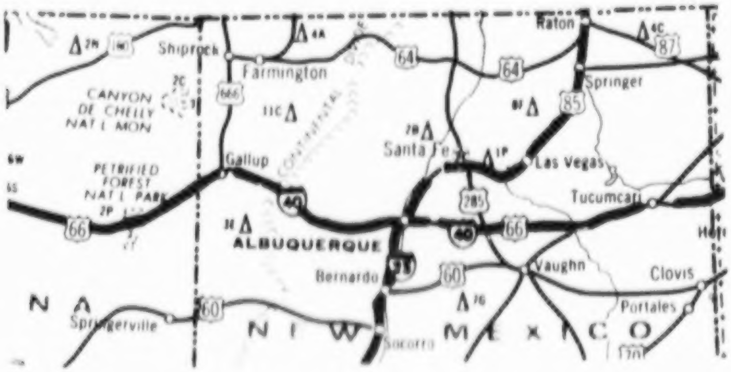
FIGURE 2



INFORMATION SHEET

C. Uses maps to identify transportation routes.

FIGURE 3


Shiprock
Farmington
Raton
Springer
CANYON DE CHELLY NAT'L MON
PETRIFIED FOREST NAT'L PARK
Gallup
Santa Fe
Las Vegas
Tucumcari
ALBUQUERQUE
Bernardo
Vaughn
Clovis
Portales
Springerville
Socorro
CONTINENTAL DIVIDE
N E W M E X I C O
64
87
85
666
66
40
285
25
60

VIII. Railway transportation

A. Is a system of moving people and materials in vehicles that run on rails.

(NOTE: More rail transportation is used for moving freight than people because it is relatively slow.)

B. Rails may be above, below, or at ground level.

1. Above — Monorails, elevated railroads
2. Below — Subways
3. Ground level — Standard trains

C. The basic types of vehicles used on railroads are engines and railroad cars such as boxcars, flatcars, and hoppers.

D. Rail transportation is primarily used for commercial transportation.

E. Commercial passenger lines include AMTRAK and rapid transit trains.

F. Commercial freight lines include B & O, Santa Fe, and Union Pacific.

IX. Air transportation

A. Is a system of moving people and materials in vehicles (aircraft) through the air.

(NOTE: More air transportation is used for moving people than freight because it is expensive.)

INFORMATION SHEET

B. The basic types of vehicles used include (Transparency 5)

1. Lighter-than-air craft
    a. Hot air balloon
    b. Dirigible (rigid airship)
    c. Blimp (nonrigid airship)
2. Heavier-than-air craft
    a. Airplanes
        1) Internal combustion, piston-type engines
        2) Turbojet and turboprop engines
    b. Gliders
    c. Helicopters

C. Air transportation is used for personal, commercial, and government transportation.

1. General aircraft are the smaller planes that carry fewer people and less cargo for personal transportation and business purposes.
2. Commercial aircraft are airplanes that carry passengers, mail, and cargo over the air routes.
3. Military aircraft are planes designed for specific military use, such as fighter planes, bombers, and cargo planes.

X. **Airways and airports**

A. Airways are the routes that aircraft take in air transportation.

B. Airways are divided into zones and air layers so that aircraft can be separated from each other by airspace for safety reasons.

C. Airports are where air flights begin and end. (Transparency 6)

D. Airports consist of the following:

1. Terminal — Houses airline offices, ticket counters, restaurants, baggage areas, gates for boarding and exiting
2. Runways — For take-offs and landings of aircraft
3. Taxiways — Connect runways and terminal
4. Control tower — For monitoring flights in the area

INFORMATION SHEET

XI. **Water transportation**

A. Is a system of moving people and materials in vessels through the water.

B. The basic types of vessels used include

1. Ships — General cargo ships, tankers, containerships, cruise ships

2. Barges — Usually flat bottomed for transporting cargo; usually propelled by towing

3. Tugboats and towboats — Used for pushing and pulling ships and barges

C. Water transportation is used for personal, commercial, and government transportation.

1. Personal transportation includes the use of boats and ships for travel and recreation.

   Examples: Skiing, fishing, sailing

2. Commercial transportation includes ocean liners for transporting people on cruises as well as cargo liners or freighters that transport cargo on regular schedules and tramps that do not operate on a fixed sailing schedule.

3. Government transportation includes the many vessels used by the military (especially the Navy) for national defense and service such as battleships, aircraft carriers, submarines, and patrol boats.

XII. **Types of waterways** (Transparencies 7 and 8)

A. Sea lanes — Go across oceans to connect major ports of the world.

1. Ports are locations where ships load or unload passengers or cargo.

   Examples: New York, New Orleans, Houston, Hong Kong, Amsterdam

2. Canals are watercourses that may be constructed through existing land to shorten routes around large areas of land. Canals use locks for movement. (Transparency 8)

   Examples: Suez, Panama, Erie

B. Inland waterways — Allow travel of people and cargo inland and connect rivers with major ports.

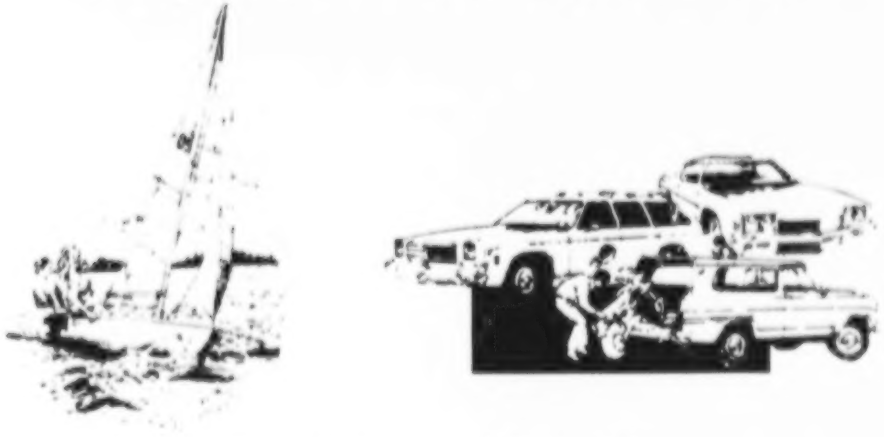
Examples: Great Lakes-St. Lawrence Waterway, Mississippi River Waterway, Columbia River-Snake River Waterway

INFORMATION SHEET

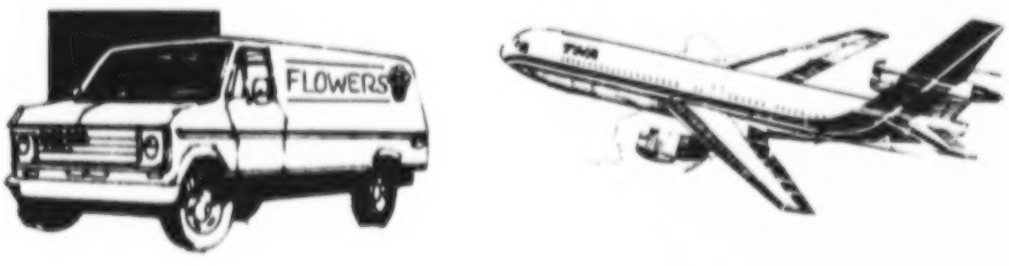
XIII. **Stationary transportation**

- A. Is a system of moving people or materials on or through devices that do not move or move only within the confines of the device.
- B. Devices for moving people (Transparency 9)
  - 1. Elevators — Have metal frames that run on rails on each side of the elevator shaft; are connected to cables powered by electric and/or hydraulic systems.
  - 2. Escalators — Are power-driven flights of stairs arranged in an endless belt that ascends and descends continuously.
  - 3. Moving sidewalks — Are power-driven steel and rubber belts designed to move people on flat surfaces that have side rails and moving handrails for passengers to hold.
- C. Devices for moving materials (Transparency 10)
  - 1. Pipelines — Move many types of materials through metal or plastic pipes depending on type of material and distance required.
    - a. Common materials transported through pipelines include
      - 1) Oil
      - 2) Water
      - 3) Natural gas
      - 4) Waste materials
      - 5) Minerals (mixed with water into slurry form)
    - b. Pipelines may be underground or aboveground.
    - c. The most famous oil pipeline is the Trans-Alaska pipeline which began construction in 1973.
  - 2. Conveyor systems — Move materials by way of a mechanical device over a fixed path.
    - a. Belt conveyors — Use rubber and reinforced steel wire belts
    - b. Roller conveyors — Use connected metal ladders with a series of rollers
    - c. Bucket conveyors — Use containers to carry loose materials to another level

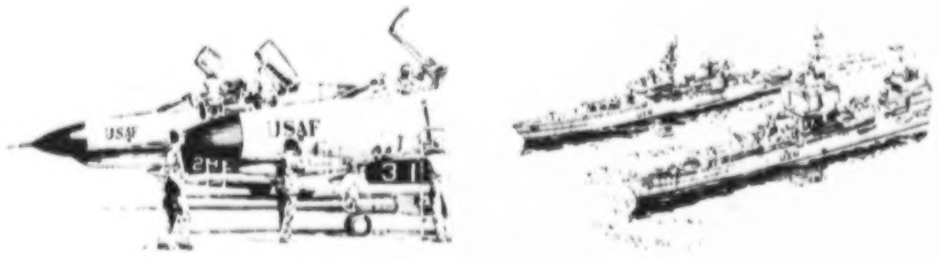
Purposes of Transportation



For Personal Benefit

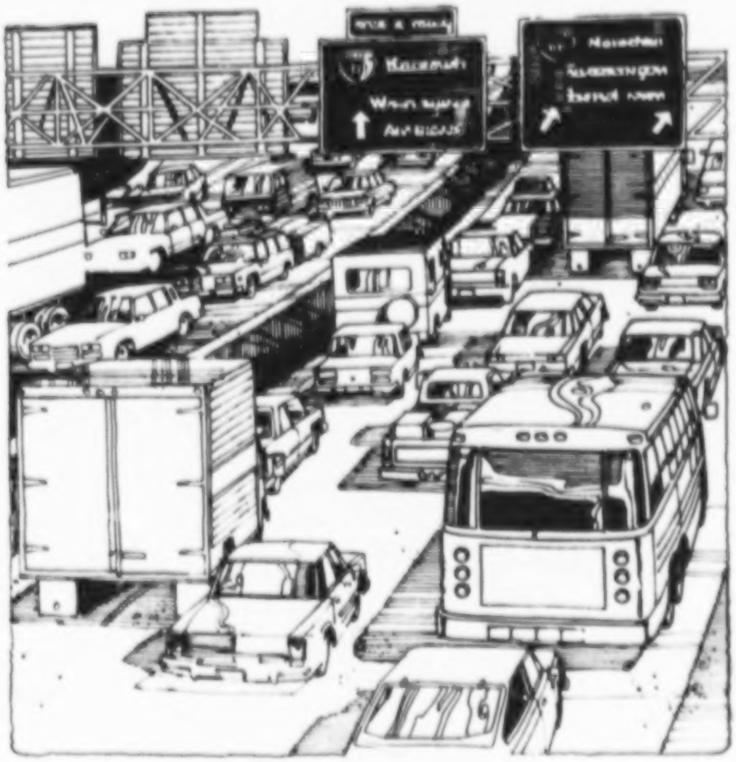

FLOWERS
TWA

For Commercial Gain

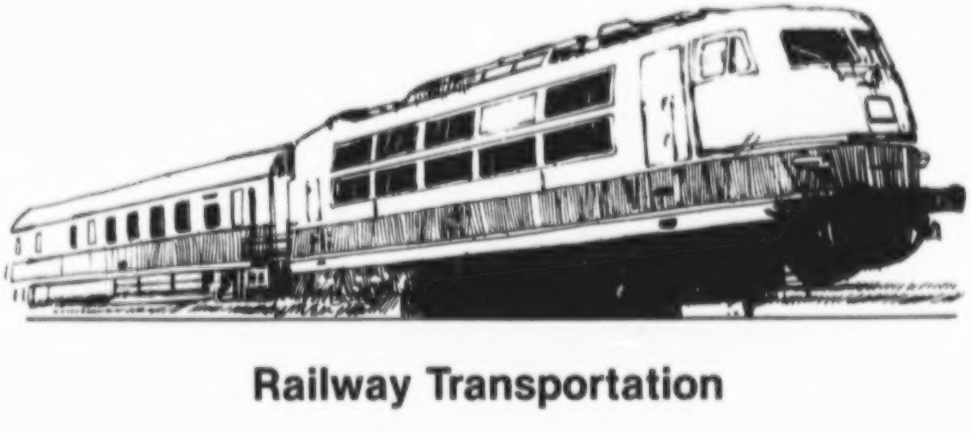

USAF
USAF
24
31

For Government Service or Defense

Land Transportation



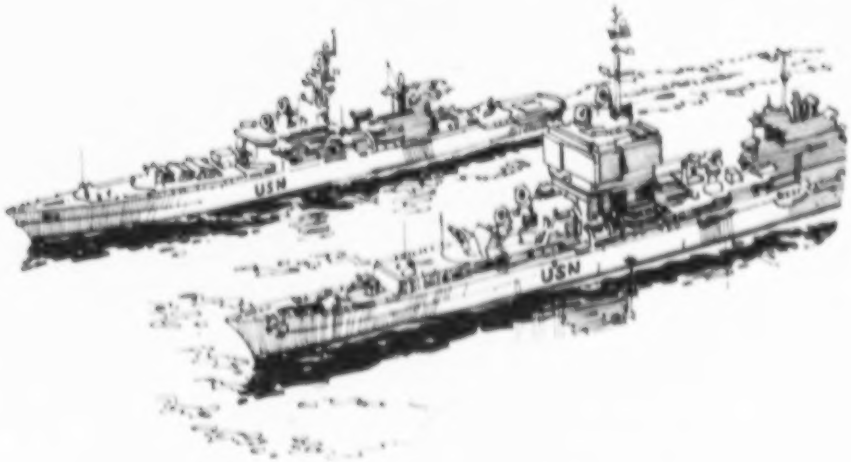
Highway Transportation

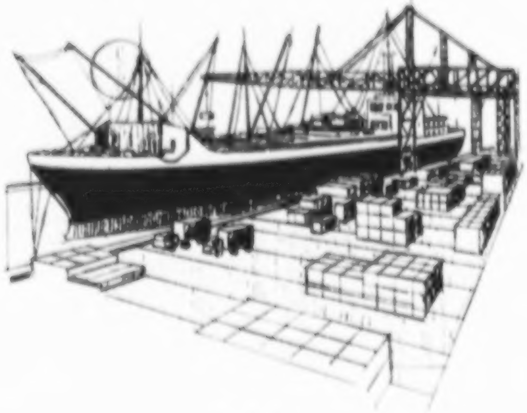


Railway Transportation

ETE-165-E

Water Transportation

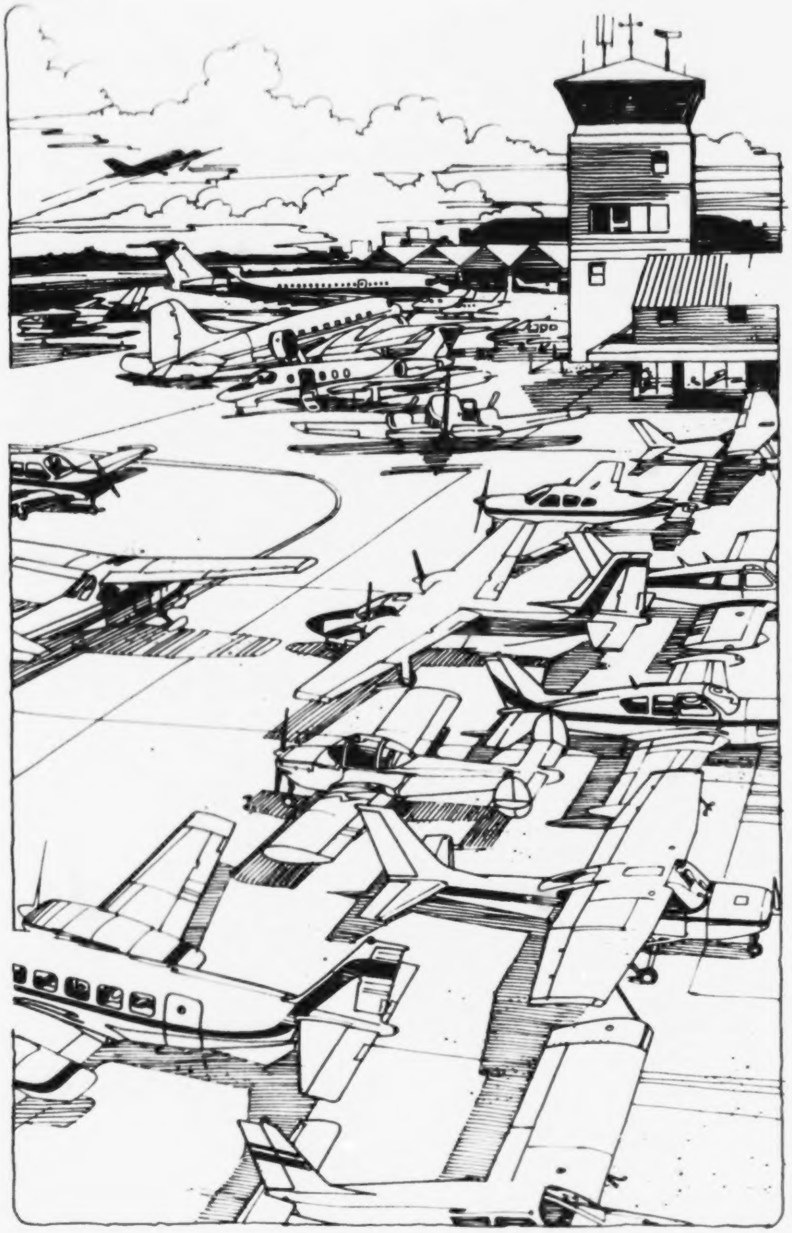




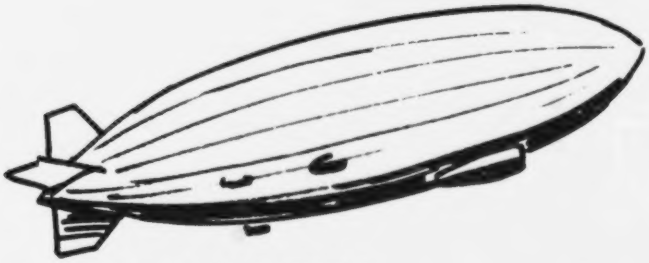
TM 3

ETE-167-E

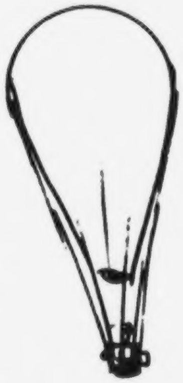
Air Transportation



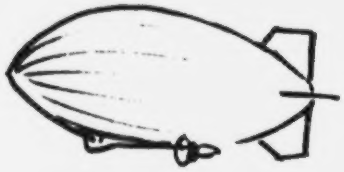
Types of Aircraft



Dirigible (Rigid)

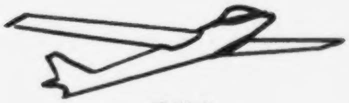


Hot Air Balloon

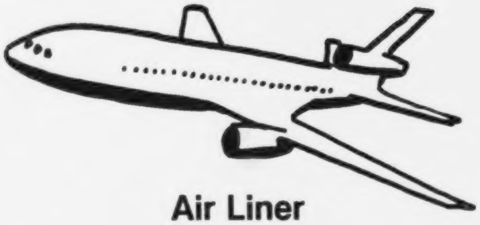


Blimp (Nonrigid)

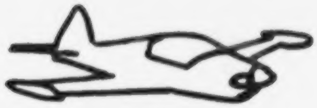
Lighter-Than-Air



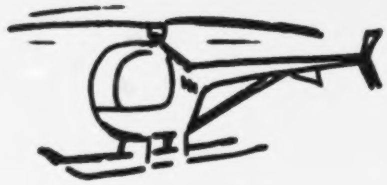
Glider



Air Liner



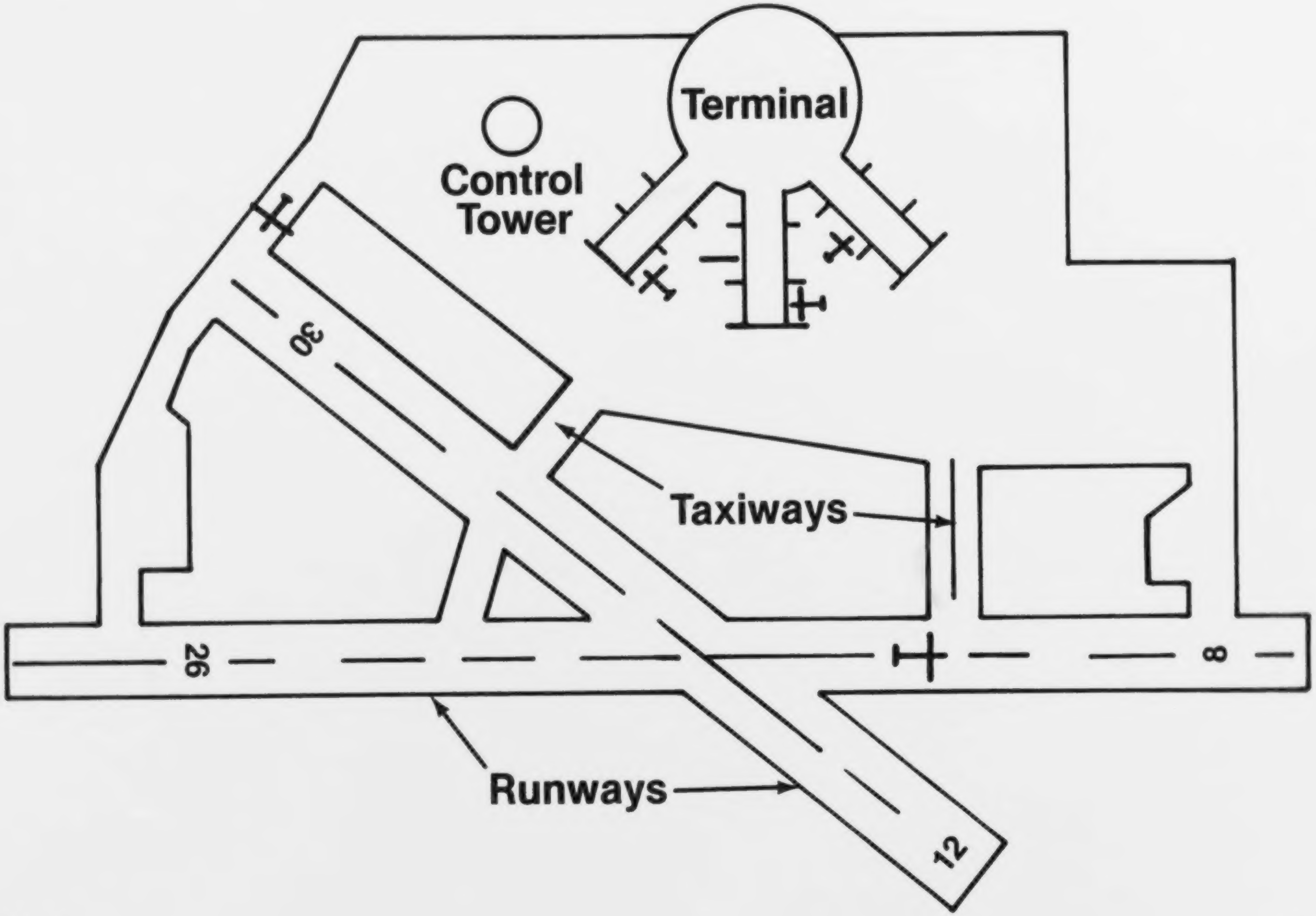
Private Plane



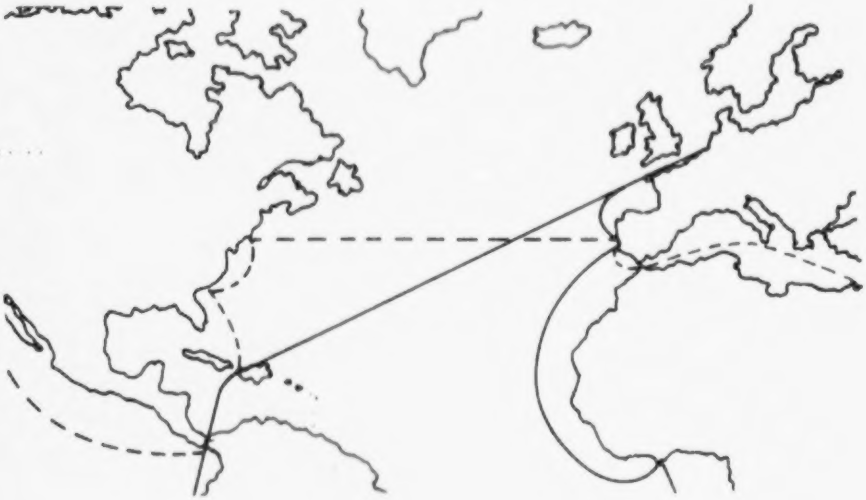
Helicopter

Heavier-Than-Air

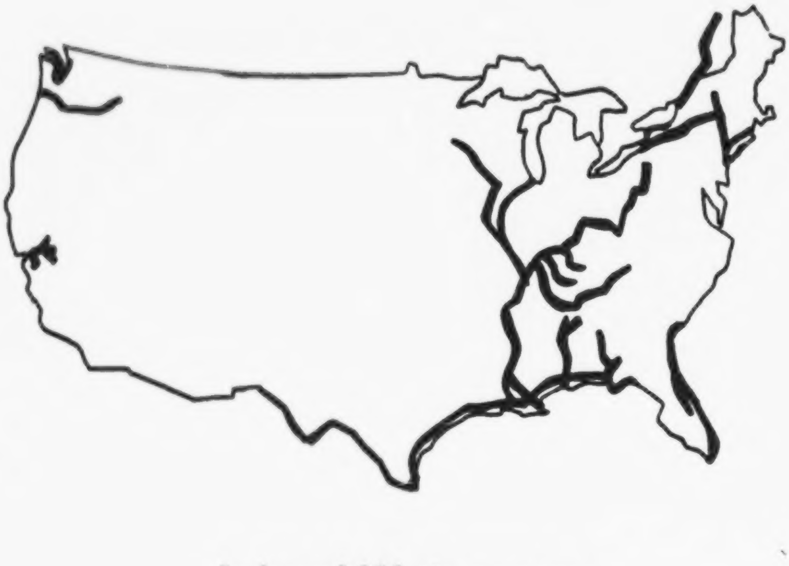
Parts of an Airport


Terminal
Control Tower
30
Taxiways
26
8
Runways
12

Waterways

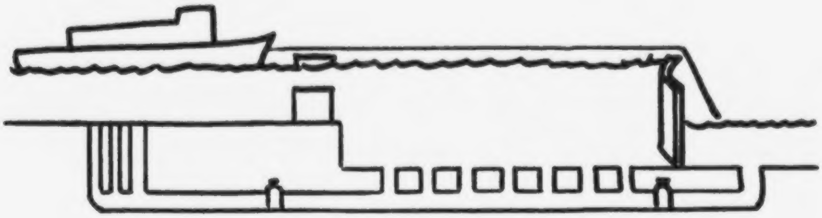


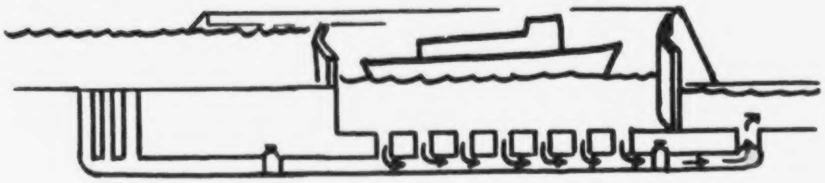
Sea Lanes
(Atlantic Ocean Shown)

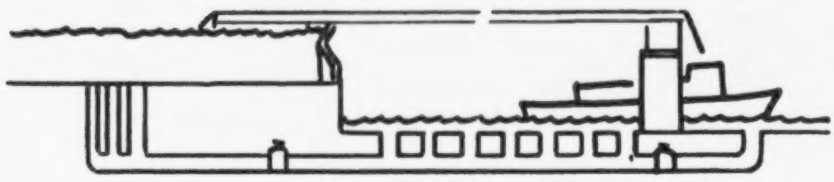


Inland Waterways
(Continental U.S.)

Operation of a Canal

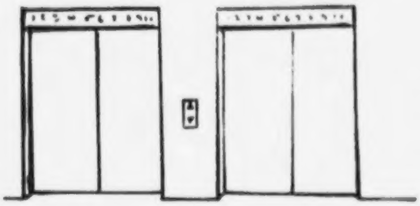




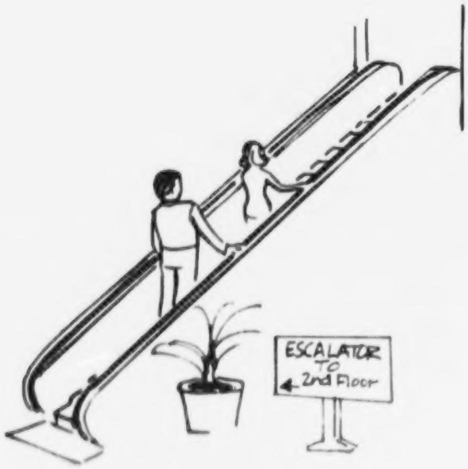


Stationary Transportation

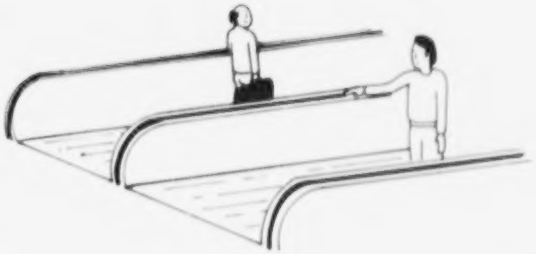
For Moving People



Elevator


ESCALATOR
TO
2nd Floor

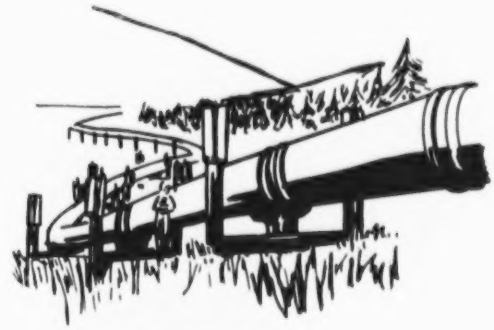
Escalator



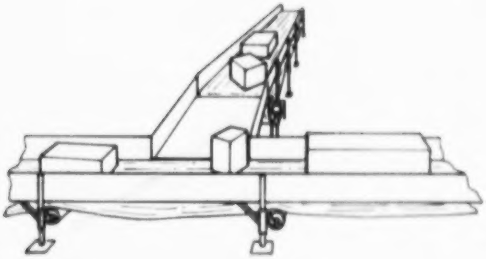
Moving Sidewalk

Stationary Transportation

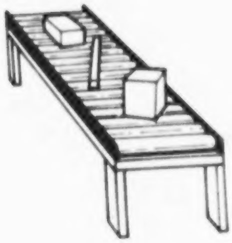
For Moving Materials



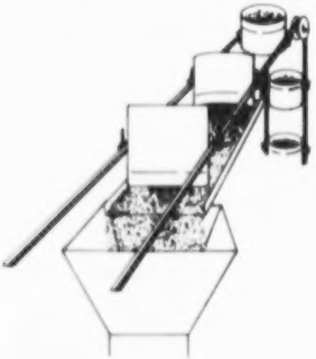
Pipelines



Belt



Roller



Bucket

Conveyors

TRANSPORTATION SYSTEMS
UNIT IV-E

ASSIGNMENT SHEET #1 — CALCULATE GAS MILEAGE PROBLEMS

NAME ____ SCORE ____________

Directions: Calculate the following problems using this formula:

$$\text{Miles Per Gallon (MPG)} = \frac{\text{miles}}{\text{gallons}}$$

1. Miss Jones drove home from college and used $7\frac{1}{2}$ gallons of gasoline. Her home is 200 miles from college. What was her MPG?

   MPG = ____________

2. Joe drove 300 miles using 9 gallons of gas. What was his MPG?

   MPG = ____________

3. Mr.Weaver used only 8 gallons to drive 322 miles. What was his MPG?

   MPG = ____________

ASSIGNMENT SHEET #1

4. Mrs. Baker drove 150 miles and used 16 gallons of gas. What was her MPG?

MPG = ____________

5. Sara drove 220 miles and used 11 gallons of gas. What was her MPG?

MPG = ____________

6. Discussion — What type of gas mileage (MPG) does your family car get? Is it a small compact or a larger car/truck?

____

____

____

____

TRANSPORTATION SYSTEMS
UNIT IV-E

ASSIGNMENT SHEET #2 — CLASSIFY GOODS, SERVICES, AND RAW MATERIAL RECEIVED AND TRANSPORTED FROM YOUR COMMUNITY

NAME ______________________________ SCORE __________

Directions: Classify goods, services, and raw materials received in your community and transported from your community and tell how they are transported.

INCOMING

ITEM	TYPE	HOW TRANSPORTED
Food	1. 2. 3.	
Clothing	1. 2. 3.	
Utilities	1. 2. 3. 4.	
Emergency Health Care	1. 2.	
Communication (Electronic)	1. 2. 3.	
Communication (Printed)	1. 2.	
Raw Materials	1. 2. 3.	

ASSIGNMENT SHEET #2

List below the raw materials and manufactured goods that are shipped from your community.

OUTGOING

ITEM	TYPE	HOW TRANSPORTED

TRANSPORTATION SYSTEMS
UNIT IV-E

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

1. 26.67 MPG
2. 33.34 MPG
3. 40.25 MPG
4. 9.375 MPG
5. 20 MPG
6. Evaluated to the satisfaction of the instructor

Assignment Sheet #2 — Evaluated to the satisfaction of the instructor

TRANSPORTATION SYSTEMS
UNIT IV-E

NAME ______________________________ SCORE ______________________

TEST

1. Match the terms on the right with the correct definitions.

_____a. A particular form or way of doing something

_____b. The use of containers in intermodal transportation

_____c. People who are being transported from place to place

_____d. Solid, liquid, or gaseous material being moved from one place to another

_____e. The movement of people and material

_____f. The beginning and ending points for loading and unloading passengers and cargo

_____g. Transportation devices

1. Break bulk cargo
2. Bulk cargo
3. Cargo/freight
4. Containerization
5. Intermodal transportation
6. Mode
7. Passengers
8. Terminals
9. Transportation
10. Vehicles

2. Classify parts of a transportation system according to a systems model by placing an "I" for input, a "P" for process, an "O" for output, and an "F" for feedback next to the correct parts.

_____a. Energy

_____b. Monitoring the process and correcting problems

_____c. Planning, organizing, controlling, directing

_____d. People

_____e. Relocation of people and materials

_____f. Capital

_____g. Preparing to move, moving, completing the move

TEST

3. Select from the following list the correct purposes of transportation by placing an "X" in the appropriate blanks.

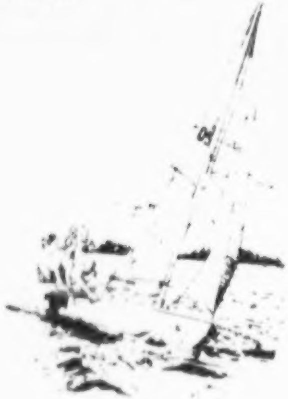
   ______a. For commercial gain

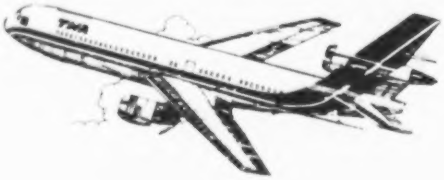
   ______b. For government service or defense

   ______c. For national communication

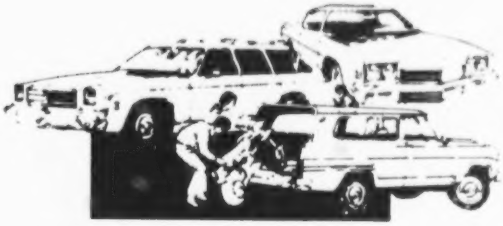
   ______d. For personal benefit

4. Identify the following environment modes of transportation. Don't identify the vehicle, just the mode.





a. ______________________________ b. ______________________________



c. ______________________________

TEST

5. List three transportation ways other than the one given.

   Example: Waterway

   a. ____________________

   b. ____________________

   c. ____________________

6. Complete the following statements concerning highway transportation by correctly filling in the blanks.

   a. Highway transportation is a system of moving __________ and __________ through a network of roads and highways.

   b. Vehicles used on roads and highways include __________ and __________.

   c. Vehicles are independently controlled on the highway by the __________.

   d. Highways are used for personal, commercial, and __________ transportation.

   e. Commercial passenger service includes __________ service, local and regional bus lines, and large inter-city bus lines.

   f. Commercial freight service includes trucks and large tractor-trailers such as __________.

7. Select true statements concerning the highway network by placing an "X" next to the true statements.

   _____a. Consists of local roads and streets through towns and cities

   _____b. Uses road signs and symbols to direct traffic

   _____c. Is primarily used for government transportation

   _____d. Uses maps to identify transportation routes

8. Complete the following statements concerning railway transportation by circling the correct words.

   a. Is a system of moving people and materials in vehicles that run on (**highways, rails**).

   b. Monorails are (**below, above**) ground level.

   c. Rail transportation is primarily used for (**personal, commercial**) transportation.

   d. Commercial freight lines include (**Santa Fe, AMTRAK**).

TEST

9. Select true statements concerning air transportation by placing an "X" next to the true statements.

______a. The basic types of vehicles used include hot air balloons, airplanes, gliders, and helicopters.

______b. Air transportation is primarily used for personal transportation.

______c. Military aircraft are planes designed for specific military use, such as fighter planes, bombers, and cargo planes.

______d. General aircraft are the larger planes that carry more people and cargo for personal transportation and business purposes.

10. Complete the following statements concerning airways and airports by correctly filling in the blanks.

a. ____________ are the routes that aircraft take in air transportation.

b. These routes are divided into ____________ and ____________ so that aircraft can be separated from each other by airspace for safety reasons.

c. ____________ are where air flights begin and end.

d. They consist of the terminal, runways, taxiways, and ____________.

11. Complete the following statements concerning water transportation by placing the correct number designations in the appropriate blanks.

______a. ____________ are usually flat bottomed for transporting cargo; usually just propelled by towing

1) Ships
2) Tugboats
3) Barges

______b. ____________ transportation includes the use of boats and ships for travel and recreation.

1) Commercial
2) Personal
3) Government

______c. ____________ transportation includes ocean liners for transporting people on cruises as well as cargo liners or freighters that transport cargo on regular schedules and tramps that do not operate on a fixed sailing schedule.

1) Personal
2) Government
3) Commercial

TEST

12. Distinguish between types of waterways by placing an "X" next to the description of sea lanes.

_____a. Go across oceans to connect major ports of the world

_____b. Allow travel of people and cargo in a country and connect rivers with major ports

13. Complete the following statements concerning stationary transportation by circling the correct words.

    a. (**Escalators, Moving sidewalks**) are power-driven flights of stairs arranged in an endless belt that ascends and descends continuously.

    b. The most famous oil pipeline is the (**Trans-Atlantic, Trans-Alaska**) pipeline which began construction in 1973.

    c. (**Belt conveyors, Bucket conveyors**) use containers to carry loose materials to another level.

    d. Waste materials, oil, and gas are common materials transported by (**pipelines, conveyor systems**).

(NOTE: If the following activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

14. Calculate gas mileage problems. (Assignment Sheet #1)

15. Classify goods, services, and raw materials received and transported from your community. (Assignment Sheet #2)

TRANSPORTATION SYSTEMS
UNIT IV-E

ANSWERS TO TEST

1. a. 6
   b. 4
   c. 7
   d. 3
   e. 9
   f. 8
   g. 10

2. a. I
   b. F
   c. P
   d. I
   e. O
   f. I
   g. P

3. a, b, d

4. a. Water
   b. Air
   c. Land

5. a. Highway
   b. Railway
   c. Airway

6. a. People, materials
   b. Any two of the following: Bicycles, motorcycles, cars, buses, trucks
   c. Driver
   d. Government
   e. Taxi or limousine
   f. Any one of the following: Tankers, refrigerated vans, flatbed trailers

7. a, b, d

8. a. Rails
   b. Above
   c. Commercial
   d. Santa Fe

9. a, c

10. a. Airways
    b. Zones, air layers
    c. Airports
    d. Control tower

11. a. 3
    b. 2
    c. 3

ANSWERS TO TEST

12. a

13. a. Escalators
    b. Trans-Alaska
    c. Bucket conveyors
    d. Pipelines

14.-15. Evaluated to the satisfaction of the instructor